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# THE PHILOSOPHY OF CLOTHING.

BY W. MATTIEU WILLIAMS.

## XIII.—A PEDESTRIAN'S OUTFIT.—TOWEL SHIRTS.

MY own experience of woollen clothing, which has been somewhat critical as regards transitions of temperature, confirms that of Rumford and the other cases already described. My first long pedestrian excursion, which extended across France, through Switzerland, and onwards through Italy, Sicily, Greece, and a little of Turkey, and occupied above twelve months, was made when I was just out of my teens, and quite a greenhorn. Starting in June, and going southward, I supposed that light clothing was the thing, and accordingly wore cotton trousers, cotton vest, a thin "Orleans cloth" coat, and linen shirts. The inconvenience of this (with no second suit, as a matter of course) soon became apparent, especially when benighted at such places as the summit of Mont Pilatus, the Grands Mulets of Mont Blanc, the Mont Mort above St. Bernard, &c. I had, however, even then learned that woollen socks were cooler than cotton for a day's walk, and afterwards read Rumford's essay and what Dr. Andrew Combe wrote on the subject. The result was a gradual modification of pedestrian outfit, culminating in that which I prepared for my trip "Through Norway with a Knapsack" in 1856. I will describe this, as it practically fulfilled my theoretical expectations.

Two soft woollen shirts of best quality, unmixed with cotton, and made to fit very loosely. Four pairs of woollen socks, thick and soft. Coat, vest, and trousers of home-spun shepherd's-plaid made in the Highlands; the coat of ordinary shooting-coat pattern and lined with coarse Welsh flannel; the vest lined with the same. Thus all was woollen material excepting at the lower part of the trousers, which were covered outside with thin leather nearly up to the knees. This addition was suggested by experience of the ragging effect of much walking upon the lower part of the trouser-legs where they rubbed together, or occasionally caught the heels of thick boots. This trouble may be escaped by wearing knickerbockers, but they are open to serious objection if garters or other ligature is used for holding up the stockings. Some of the readers of KNOWLEDGE may be able to state their practical experience as to the necessity of these. I have not tried them.

Garters are mischievous because they may obstruct the free upflow of the blood in the veins, and thus induce congestion and varicose veins below.

My boots had woollen cloth tops, thick and very broad soles, of course, with ample studding of hob nails. (These boots will be described more particularly when I come to the subject of foot clothing.) Hat of soft white felt, with very broad brim: should *now* substitute for this a Panama grass hat. I took a few linen shirt-collars, but soon threw them away as absurdities.

I had no sort of overcoat or "change" beyond the one shirt and spare socks, and had no need of such incumbrance. When the weather was cold I wore my vest, and buttoned my coat over it; when hot I removed the vest and opened the coat; when sultry I removed both coat and vest, and slung them to my knapsack. When benighted on a mountain I wore my extra shirt over my vest and trousers, wore two pairs of socks on my feet, and one on my hands as mittens. I have slept fairly well for a few hours thus on very cold nights, always selecting a bed of bare rock where crisp heather was not available, and carefully avoiding grass and ordinary vegetable soil, which is dangerous. Never sleep on the ground at the bottom of a valley. The hill slopes, though cooler, are much drier and safer.

The knapsack itself was a special invention of my own, then quite new, but now largely adopted. It was a wicker basket, lined *inside*. I had suffered great inconvenience from the confinement of the perspiration where a leather knapsack touches the back, and tried the wicker experiment with complete success.

It will be learned from this that all the clothing in the knapsack was three pairs of socks and the one off-shirt. But how about a night-shirt? is a natural and proper question. As we are now in the holiday season, and many of my readers are pedestrians, or, if not, should be, I will repeat the instructions concerning shirt manipulation which I published in the well-known story of this trip. By following these you may, with one shirt on and one shirt off, have a clean shirt every day and a change night and morning. It is managed thus:—

Suppose the hour to be 10 a.m. You have walked some distance, are getting hot, and disposed for a halt. You make for the river, lake, or the first brook or mountain torrent that crosses or approaches your path; and such are always to be found in the sort of country that pedestrians travel. Call the shirt on A, and the shirt off B. Unhook your knapsack at a cosy nook by the waterside, take out shirt B, and wash it in the stream—a very simple operation, as such a shirt, worn but one day, merely requires a little beating and wringing in the pure water, with possibly a suggestion of soap at the wrists and armpits. This done, spread out the shirt on the grass, and take your bath. By the time you are dressed, the shirt is half dry; to complete the drying, tie it to your knapsack, and let it dangle and wave behind you for an hour or two, as you walk on. Now let it be 5 p.m. of the same day. You are hot and just sufficiently tired to enjoy the luxury of repose; you retire to the adjoining field or into the forest to dress for dinner, by taking off shirt A and putting on shirt B, which is cool and fresh, and savours of the sweet, clear water of the mountain stream; you spread out shirt A to ventilate; you make up your diary, lie flat on your back, and look through the branches of the trees into the blue infinity above,

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build castles in that region for half-an-hour or so, then pack up shirt A, and do the last stage of your day's walk at a swinging pace in the cool evening. Shirt A does duty as a night-shirt, B is resumed on the next morning, when A "goes to the wash," as B did the day before.

The success or failure of a pedestrian excursion of any length depends primarily on the reduction of luggage. Everybody takes too much. I did so on this occasion, having included a comb and hair-brush, besides the above-named collars. On reaching Christiania I had my hair cut. The operator used very long shears, and presently I discovered that there remained on my head nothing to brush, and less to comb. The Norwegians clip their horses annually, themselves likewise, and in the same degree. The only occasion on which I did not take an excess of luggage was on a suddenly extemporised trip through Belgium, the Rhine, Bavaria, the Tyrol, Venice, the Italian lakes, Alsace *viâ* the Splügen and Zurich, thence by the Moselle to Nancy, and from Nancy to Paris by rail. My luggage on starting from London by the Dunkirk packet was a penny sheet of brown paper and a bit of string. Every other requirement was purchased on the way as the demand arose. The natural course of evolution in this case finally converted the sheet of paper into a German satchel filled with handbooks and photographs. If you eat a raw turnip or a hard apple every morning, the supposed necessity for a tooth-brush is refuted by a *reductio ad absurdum*.

So far I have only considered clothing material in relation to its resistance to the passage of heat and the transpiration of aqueous vapour. The saline constituents of the perspiration are very variable in composition; varying with different individuals, and in the same individual at different times, according to the conditions of health, exercise, climate, and food. To these variations I attribute the contradictory results obtained by able chemists and physiologists who have collected and analysed these secretions. I will not enter upon the details of such analyses, especially as I have recently discussed them in connection with the physiology of nutrition in my papers on "The Chemistry of Cookery."

At present it is sufficient to note that there are given out either urea itself or nitrogenous salts of similar composition and physiological significance; salts which are products of the degradation of tissue, and therefore constituting excrementitious matter, which is more or less poisonous, and should be removed. The foulness of the arm-pit portion of a dirty shirt, or the feet of over-worn socks, indicate this, and prove the necessity of frequent changing of underclothing.

In reference to these, I am inclined to conclude that my towel shirts, described in the last paper (I learn that the technical name of the material is "huckaback"), are better than flannel. Flannel assists gaseous transpiration better than the towelling; but this is decidedly superior to flannel in removing the liquid perspiration, and all that it holds in solution. This may be tested by simply washing one's face, and then wiping it with flannel, as against good soft huckaback. Therefore, I conclude that persons who are troubled with excessive liquid or sensible perspiration may find the towel shirts even better than flannel. Should any of my readers repeat my experiment, they will do good service by recording the results.

The experience of furnace-men is in favour of such material. I have seen much of them, and find that the "mop," which is thrown loosely round the neck or over the shoulders, and used for wiping or mopping the face and breast, is usually of towelling material. I do not remember ever to have seen a flannel one in use, either above ground or in a coal-pit. The comfort of the huckaback shirt is unquestionable.

## ILLUSIONS OF THE SENSES.

By Richard A. Proctor.

(*Continued from page* 40.)

THE sense of heat is in like manner usually associated with the sense of sight, so that illusions affecting it are either corrected or modified by visual impressions. Yet there are cases where this sense is deceived when acting alone. For instance there is the well known experiment in which after one hand has been placed for a time in water as hot as can be borne, and the other in ice-cold water, both hands are plunged simultaneously into tepid water. Immediately the hand which had been in very hot water recognises a comfortable sense of coolness, and as it were pronounces the water cold; the other hand as quickly recognises a comfortable sense of warmth and pronounces the selfsame water hot. Here even sight will not correct the illusion. We see as plainly as possible that both hands are in the same basin, yet one hand seems to be in warm water the other in cold. I find a singular effect produced if while the attention is strongly directed to the circumstance that both hands are in the same water, the hands are freely moved about in the water. For it seems then as though there were currents of hot and cold water in the same basin, moving so as to follow or rather to accompany the hands.

Without making definite experiment in this way, we can easily in the ordinary experiences of life, recognise the readiness of the heat sense to be deceived. Thus we come out of a warm room into the hall outside and find the air there pleasantly cool. We then, perhaps, see a friend home through the cold night air and presently return to the same hall. But now, coming into it from the cold outer air, we find it pleasantly warm.

Professor Le Conte remarks that "during the Arctic voyages made by Parry, Franklin, Ross, Kane, Nares, and others, it was found that a zero temperature seemed quite mild after the thermometer had been twenty or thirty degrees below that point." But, although in California temperatures of twenty or thirty degrees below zero may not be common, an American has no occasion to leave the United States, or even the middle states, to experience the illusion in question. I have repeatedly walked along the streets of New York with the temperature a degree or two below zero, without wearing an overcoat or feeling the want of one, when such a temperature has followed a few days of much colder weather. And conversely, even as I write I am feeling unpleasantly cold at Columbia, South Carolina, with the temperature only just below zero (and the air still), simply because I have been enjoying during the last few days in Charleston, S.C., a soft and balmy warmth resembling that of a June day in England.

Again in caverns like the Mammoth Cave, Kentucky, or Kent's Hole in Devonshire, there is in summer always a sense of coldness and in winter always a sense of heat, yet in reality the thermometer shows that, as might be expected, the air is somewhat warmer within such caves in summer than it is in winter. Here, then, the illusion is not only incorrect but the very contrary of the truth, the air seems colder when it is really warmer and warmer when it is really colder. Because the range of tempera-

ture is much less within the cave than in the open air, we are deceived into the idea that the temperature really ranges the reverse way from that in which it actually varies.

A more subtle illusion relating to heat is that arising from difference in the conducting power of various substances with which the skin is brought into contact. Thus if we plunge into water of the very same temperature, when tested by the thermometer, as the surrounding air, both being really cooler than the body, the water seems cold, because being a better conductor than air, it immediately begins to carry off more of the body's warmth. On the contrary, the self-same substance—water—not only feels hot but is unbearably hot when at a temperature far below that of the surrounding air in a Turkish bath.

It is to be noticed that in this case the sense of heat while in one respect leading to an erroneous idea, in another and a much more important point gives correct information. If one were to trust the teachings of the thermometer, and infer that one might as well remain in water as in air seeing that the water and the air are of the same temperature, one would make a serious mistake, and suffer a good deal of harm through the rapid abstraction of warmth from the body. The heat sense, by telling us wrongly that the water is colder than the air, conveys at least the much more important information that we are losing heat while in the water,—and therefore saves us from the danger of getting unduly chilled, as we might if we trusted to the thermometer alone. In the reverse case, the sense of heat acts even more directly and emphatically for our benefit. I remember a case in point which occurred at the Hummums. Some one who had heard that the temperature of water in the hot rooms is always much lower than the temperature of the air, but had not considered the matter with actual reference to the requirements of the human body, supposed that he would gain decidedly in comfort if instead of sitting on the non-conducting felt or flannel of the seats, he were to substitute a roll of towels well soaked in water. He found as a matter of fact that the arrangement thus suggested by the thermometer was very far from being welcomed by the nerves of touch,—whose repugnance to the arrangement was indeed most emphatic.

It is hardly necessary to say, perhaps, that the whole question of clothing, especially for young people, depends on the relation between the conducting powers of various substances used for clothing. In this matter the sense of heat gives more trustworthy information than the thermometer, clothes which seem to be of the same temperature if tested by the thermometer affording very different degrees of protection against the loss or the too rapid accession of heat.

In passing, I may note here an important consideration as to the clothing proper for children. In their case as in the case of grown folk the sense of heat gives the best information as to what is really desirable in the way of clothing. But grown people are apt to forget the experiences of their childhood, and to decide what is best for children from their own ideas as to what ought to be best. A child complains of cold or of heat sooner than a grown person; but much less attention is paid to the complaints of children on such matters than to our own slightest suggestions of personal discomfort. And children are much less carefully guarded against heat and cold than grown persons guard themselves. The idea seems to be that children can stand any changes of temperature; though, oddly enough, children's own idea (which is really not very far from the truth) that they can stand anything in the way of rich and indigestible eating, is not much considered by older persons. Now when a child shows by its words or actions that it suffers sooner from changes of temperature than grown people do, it in reality expresses its sense of an important truth. A child cools and warms more quickly than a man; for precisely the same reason that a small cinder cools more quickly than a large one, or that a small fire burns out more quickly than a large furnace. Compare the case of a child three feet high with that of a man six feet high. Neglecting slight differences of build, the man is about eight times as large as the child, or contains eight times as much matter. But the surface of the man is not eight times as large as the surface of the child; it is only four times as large. Thus supposing the man and the child to come out of a warm room into the cold outer air, being both at the same temperature, the man has eight times as much heat to part with as the child has; but he only parts with four times as much heat, moment by moment, if he and the child are similarly clothed. Thus the child's loss of heat, moment by moment, though only one-fourth of the man's loss of heat, bears twice as great a ratio to the child's total supply of heat. The child will cool as much in one minute as the man cools in two minutes, or in half-an-hour as the man cools in an hour. If the weather outside is so cold that the man would suffer serious injury to his health after an hour's exposure to it, the child will suffer at least an equal injury in half-an-hour. In reality of course the child will suffer a greater injury; because apart from his more rapid loss of heat, the child's flesh is more tender and necessarily suffers more from a given loss of temperature. Similar remarks apply to increase of heat, which may be just as mischievous as access of cold. Yet we are too apt to clothe children with total disregard to the circumstance that they require to be protected much more carefully than their elders against rapid changes of temperature. Apart from all questions of propriety a man would not care even on a fairly warm spring day to go about with his arms and legs bare for any length of time; for he would feel uncomfortably cool: children suffer twice as much on such a day from undue exposure to the air; yet many foolish folk think nothing of exposing the delicate limbs of children to the cold of winter without protection. They imagine that the numbness and insensibility which really indicate the mischievous effects of the cold, and may permanently affect the child's constitution, are signs of hardening; and because only the hardier survive this cruel treatment they imagine that those hardy survivors owe the strength which enabled them to survive, to the harsh exposures by which that strength was dangerously taxed and perhaps in large measure sapped.

*(To be continued.)*

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THE "Visitation of Dorsetshire," and the "Visitation of Gloucestershire" of 1623, have just been issued by Messrs. Mitchell and Hughes to the Members of the Harleian Society. The two volumes are included in the subscription for 1885; and the second volume of the Registers of St. James, Clerkenwell, will be ready for the Members in August.

BURNHAM BEECHES.—In a special "Holiday Edition" of Mr. Francis George Heath's "Burnham Beeches," to be published immediately by Messrs. Rider & Son, of Bartholomew-close, will be included a portrait of the author, upon whose suggestion this charming tract of forest was secured for public use by the Corporation of London.

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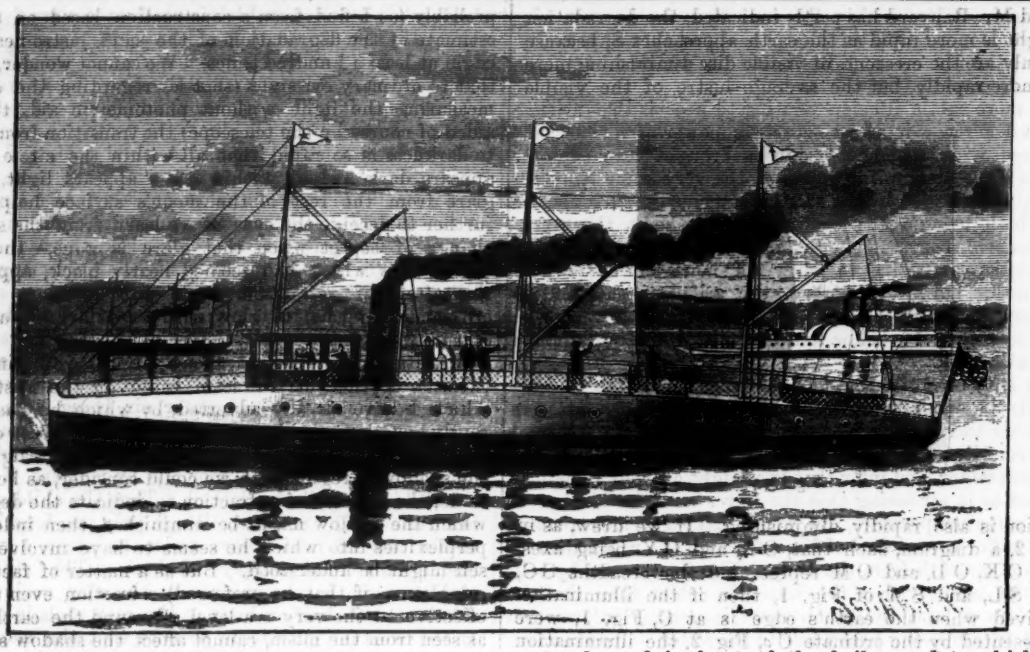


## A FAST STEAM-YACHT.

FOR more than twenty-two years the side-wheel steamboat *Mary Powell* has been recognised as the fastest boat on the Hudson River; she makes an average of twenty miles an hour, and according to a pamphlet issued by the owners, "in the year 1882, she ran at the very fast rate of 26 miles an hour between Milton and Poughkeepsie, making the four miles in nine minutes." Boats of all sorts of shapes, big and little, side-wheels and propellers, have unsuccessfully attempted to wrest from her the well-earned title of Queen of the Hudson. But on June 10 she was badly beaten in a long run by a small steam-yacht of very insignificant appearance. The run was from this city to Sing Sing, a distance of 30 miles, and was made by the steam-yacht *Stiletto* in one hour and fifteen minutes, the *Mary Powell*, on her regular trip to Rondout, being beaten about two miles.

The *Stiletto* was designed and built by the Herreshoff Manufacturing Co., of Bristol, Rhode Island. She is 94 ft. long over all, 90 ft. on the water-line, and 11 ft. beam. The hull is double planked, and sharp at both ends, the curves extending far toward the centre. A slightly arched deck covers the whole boat. Forward is a pilot-house sufficiently large to serve as a commodious cabin. Owing to the extremely small space taken up by the engine and boiler rooms, there is ample room for comfortable quarters for the crew and state-rooms for the owner, guests, and officers. Power is furnished by a compound condensing-engine of 12-inch stroke and cylinders 12 and 21 in. in diameter; the engine is supplied by a sectional water-tube boiler, in which steam can be got up quickly, and which is calculated at 450 horse-power. Although this boiler is similar in principle and operation to those of the regular Herreshoff type, it varies greatly in construction, the tubes being arranged horizontally in sets immediately over the fire—each set being at right angles to those just above it. Exhaust steam is led to a surface condenser. An ordinary pump takes the water from the condenser, forces it into the upper set of boiler tubes, through the boiler to a separator located in front of the boiler, and to which the steam-pipe is connected. The boiler will work safely with 160 lb. of steam, but in the race with the *Mary Powell* it was only found necessary to use from 120 to 125 lb. The fire-box is 6¼ ft. square.

The screw is four-bladed, 4 ft. in diameter, and 6½ ft. pitch. At the stern the boat draws 4½ ft., and at the bows 3 ft. We may notice that there are now building at the yards of Yarrow & Co., England, two torpedo boats which are expected to run, when light, at the rate of 24 knots an hour, or nearly 28 miles. The *Stiletto* must do better than 25 miles an hour before she can claim the broad title of the fastest boat in the world.—*Scientific American.*

## THE RUDDY ECLIPSE OF THE MOON.

BY RICHARD A. PROCTOR.

(*Continued from page* 47.)

IF we consider what really happens when (as supposed to be seen from the moon) the sun is passing behind the earth, and therefore the earth's shadow is thrown on the moon, we shall readily understand the increase of the earth's effective shadow-throwing diameter by about one-sixtieth part,—a circumstance which some so strangely misinterpret,* that they appear to imagine a range of 60 or 70 miles of our atmosphere above the sea-level to play a part in determining the phenomena of a total lunar eclipse!

Suppose E S E′, Fig. 1, the face of the sun when the outline of the earth E C E′ passes through C the centre of the sun's disc, *k* K *k*′, *l* L *l*′, *m* M *m*′, and *e* S *e*′ being the advancing edge of the earth at equidistant times up to the summit of geometrical totality. Then obviously, as

* The mistake is very commonly made of attributing this increase to the earth's atmosphere. In reality the earth's atmosphere has nothing to do with it.

indeed Mr. Ranyard has partly indicated, the degradation of light is more rapid as the earth approaches S, because not only are the crescents of visible disc diminishing more and more rapidly, but the average lustre of the visible

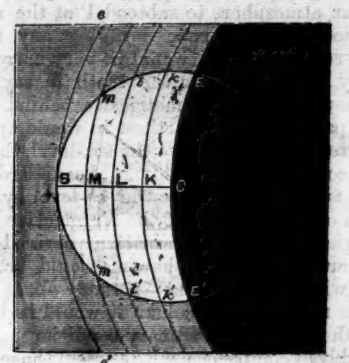



Fig 1.

portion is also rapidly diminishing. If we drew, as in Fig. 2, a diagram, such that, O X and O Y being axes, O C, O K, O L, and O M represented the breadths S C, S K, S L, and S M of Fig. 1, then if the illumination received when the earth's edge is at C, Fig. 1, were represented by the ordinate C *c*, Fig. 2, the illumination when the earth's edge reached K, L, M, Fig. 1 would be represented by such ordinates as K *k*, L *l*, M *m*. Here O M would correspond to about 4′. Suppose, now, another diagram made, as in Fig. 3, in which O M represents the O M of Fig. 2, enlarged, and M *m* represents the ordinate M *m* of Fig. 2, enlarged in much greater degree. Then the earth's further progress as S M of Fig. 1 is traversed, minute (of arc) after minute, carries the edge to the points P, Q, R, Fig. 3. The illumination-ordinates shorten now much more quickly than those in Fig. 2. We get such a curve as *m p q r*, where Q *q* is less than a fourth of M *m*, but R *r* less than a tenth of Q *q* (the real proportions are probably somewhere about this). We see then that if *s* S *s*′, Fig. 4, represent a part of the edge of the geometrical shadow of the earth on

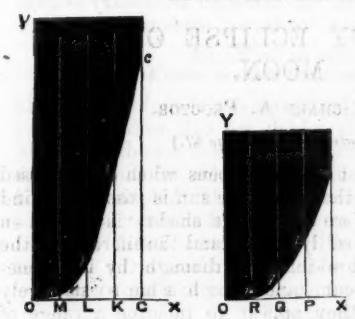



Fig. 2.




Fig. 3.

Fig. 4.

the moon, *r* R *r*′ and *q* Q *q*′ rings respectively 1′ and 2′ from that shadow, the average illumination over the area *q* R *q*′ is greater than that over the area *r* S *r*′, somewhat as the area R *r q* Q in Fig. 3 is greater than the area O R *r*. Now if O *r q p m* in Fig. 3 were a parabola, the area R *r q* Q would be seven times O R *r*. But we have seen that in passing from M to O we get ordinates shortening far more rapidly the nearer we draw to O. Hence the illumination of *q* R *q*′ exceeds the illumination of *r* S *r*′ in far greater degree than this,—probably (as I find from a construction based on a fair estimate of the degradation of the sun's lustre near the edge) at least a hundred times. We cannot wonder, then, that to ordinary eye-sight (that is, regarding the eye as measuring the light without photometric aid, though aided of course by the telescope) the transition from light to darkness is so rapid that all within the circle *r* R *r*′ appears dark and all within *q* R *q*′ appears light. The glare from the rest of the moon's surface helps still further to deceive the eye; as we learn from the sudden change of aspect when that glare is gone,—the part within *s* S *s*′ which had seemed nearly black, appearing thereafter (if refraction sends any light to it, as ordinarily happens) to glow with a considerable amount of ruddy lustre.

Mr. Ranyard's remarks about refraction diminishing the area of the shadow seem based on the mistake to which I have already adverted, by which he has apparently overlooked the exceeding narrowness of the atmospheric zone which can refract the sun's light into the shadowed region. If we could consider, as he seems to do, the amount of refraction to indicate the degree to which the shadow might be diminished, then indeed the perplexities into which he seems to have involved himself might be understood. But as a matter of fact (or of calculation, if that be preferred) refraction even though effective to the very sea-level all round the earth's disc as seen from the moon, cannot affect the shadow's *size* in the slightest degree. The size of the shadow depends on the position of the ring (see Fig. 4) at which the degradation of light is so rapid that the eye recognises a marked and sudden darkening; and this, as we have seen, must occur somewhere outside the geometrical shadow. (The question is rather physiological, though, than physical.) Refraction can temper the darkness of the umbra, but cannot in any way affect its size. All over the umbra refraction is at work, usually with tolerable uniformity, carrying a certain small proportion of sunlight, variously coloured according to atmospheric conditions, to illuminate the moon's surface. If one part of this surface is illuminated by a longer arc, or by an entire ring, than another, this other is illuminated by a broader and brighter one. All parts get nearly the same amount of light—at least, the absolute difference is everywhere very small compared with even the difference between the illumination along *r* R *r*′, Fig. 4, and that along *s* S *s*′.

So soon as no direct light from the sun falls on the moon, and only refraction—even the most effective refraction—can carry light to her surface, we have necessarily a very feeble light indeed,—even though, as I showed (or rather explained) in my former papers, the light then received is true sunlight, not merely light from our illuminated air, as Mr. Williams supposed.

Compare, for instance, the light received from a crescent of the sun 1′ wide as seen from the moon, with the light from the complete ring round the earth into which the sun is distorted when centrally behind the earth, the zone of atmosphere bordering the earth's disc being supposed two-thirds clear of clouds down to the sea-level and of its average transparency. I take the average brightness of the crescent of sunlight to be about one-fifth the average brightness of the solar disc, and the area of the crescent about 1-700th part of this disc. I also assume the average absorption of sunlight in passing through our atmosphere grazingly between altitudes 0 and two and a half miles to be 19-20ths, the ordinary coppery light of the totally eclipsed being such as to suggest at least this amount of absorption, and the real

absorption being probably considerably greater. We have then to compare two illuminations, one from an apparent surface equal to 1-700th of the sun's and of an average intrinsic lustre equal to one-fifth of his; the other from an apparent surface corresponding to two-thirds of a ring around the earth's disc, about two and a half miles in width and of only 1-20th the sun's intrinsic lustre. Now the apparent size of this ring round the earth, as seen from the moon, has been shown (see KNOWLEDGE for April 24, 1885, p. 341) to be 1-889th of the sun's apparent disc. Hence the ratio we require is

$$\frac{1}{700}\times\frac{1}{5} : \frac{1}{889}\times\frac{1}{20}\times\frac{2}{3}$$

or . . . . 5334 : 700, *i.e.*, nearly 8 to 1.

Yet we have seen that along $r\,R\,r'$, Fig. 4, or 1′ from the edge of the geometrical shadow, the eye recognises so great a loss of light that the shadow seems to occupy the space $r\,S\,r'$; how little then can any part of the shadow within $s\,S\,s'$ be affected by the small modicum of refracted light which can fall there, even under conditions rather more favourable than usually exist.

I have not thought it necessary so far to take special account of the action of the higher layers of the air, in bringing light within the geometrical shadow. This action has to be considered in two aspects. In the first

Fig. 5.

place it increases, so far as it is effective at all compared with direct light from the sun, the amount of light falling outside $s\,S\,s'$ Fig. 4. For so soon as the sun even begins to pass behind the earth, as seen from the moon, refraction is at work in bringing the geometrically hidden parts of his disc into view. But such parts must necessarily be *intensely flattened*—so to speak, and the amount of light reaching the moon through such refractive action must always be very small compared with that which arrives directly, so long as any part of the sun's face remains unconcealed (geometrically) by the earth.

Suppose, for instance, three-fourths of the sun's diameter covered, geometrically. Then the sun as seen from the moon would be wholly visible, in the shape shown in Fig. 5, the part really behind the earth being compressed into a thin zone along $e\,E\,e'$, the inner edge of this zone being raised a mile or so above the earth's true outline. (It would only reach this when the sun had passed so far into the shadow that only actual grazing refraction would bring him into view.) Beyond $e$ and $e'$ would be two fine arcs of light extending to $k$ and $k'$, where lines from C the centre of the earth's shadow touch the disc of the sun. The centre of the sun being about 8′ below (or rather within) E would be raised into view by the action of that layer of air which for an observer on earth would produce a horizontal refractive of 4′, about one eighth of the horizontal refraction at the sea-level. This would correspond to an elevation of about 11½ miles. The atmosphere 14 miles above the sea-level would bring up only about 4′ of sun breadth; the atmosphere 17½ miles high only about 2′. Now it takes a depth of nearly 70 miles of our atmosphere to subtend 1′ at the moon's distance. So that the zone bringing any appreciable amount of refracted light, would be very narrow indeed.

Probably I am far within the truth in saying that if the sun had just set geometrically behind the earth, while the part of his disc farthest in would appear about three-quarters of a mile above the sea-level, the part just within (geometrically) would not be apparently raised more than twenty miles above the sea-level by the refractive action of that portion of the air effective in bringing it into view. The illumination derived from the meniscus arc of light so showing would be very small compared with full sunlight—possibly about 1-10,000th part on the average. In colour it would be but slightly tinged with red, under ordinary conditions,—so slightly that probably by comparison with parts of the moon further within the earth's geometrical shadow, illuminated by ruddier light, this portion would look slightly bluish. It would be a very narrow zone of shadow, however.

## THOUGHT AND LANGUAGE.

By Ada S. Ballin.

### XIII.

WE have seen that the deaf-mute thinks and reasons and finds a means for expressing his thoughts; but we have not yet touched upon the question of *how* he thinks. The question of the manner in which thought proceeds is one of great interest, but it is one to which very little attention is paid except by psychologists. If an intelligent and well-educated person, with all his senses intact, is asked the usual form of his thoughts, he will generally be at a loss what to answer, and this arises from the fact that, as a rule, we think, but are not conscious of the act of thinking, and pay no attention to it. If, however, we do turn our attention inwards we find that for the most part we think in imaginary sounds. As Goethe says, man is a creature of custom:—

> Aus der Gemeine ist der Mensch
> Und die Gewohnheit nennt er seine Amme.

We are so accustomed to express our thoughts in certain varied groups of sounds which we call words, that we chiefly think, as it were, in suppressed sounds or words. It is this fact that led to the confusion of thought with speech among the ancients, who held that thought and speech are identical, except that thought "is the unuttered conversation of the soul with itself, and that the stream of thought which flows through the lips and is audible is called speech," according to Plato's summary of the matter in the "Sophist."

If we look closely into the question we find that thought and language are by no means identical, although so closely associated by habit. For example, the same thought may be expressed in half-a-dozen different ways, and we select that which seems most suitable to us, while at other times a thought presents itself to the mind and we find the greatest possible difficulty in clothing it with words. Further, while all nations have to a great extent the same thoughts, each has a different way of expressing them. I have previously compared words to coins which take the place of articles alike cumbrous for transportation or storage; and, in fact, they are handy

counters by which the exchange of our ideas is facilitated, and by which we are enabled to store in the mind a much larger number of thoughts than would otherwise be possible, and to pass with much greater rapidity from one to another. Hence, we habitually think in words (suppressed sounds), a habit based upon convenience; but we also think to a large extent in visual images and imaginary movements; and this mode of thought is particularly noticeable in our dreams. This is the mode in which the lower animals think, and when a dog starts up in his sleep with bristling hair and barks, the inference is not unjustifiable that he is dreaming of combat with some imaginary enemy. There is such a thing as abstraction by way of visual or generic image—that is to say, simple concepts may be formed by visualisation of similarities, and there is every reason to believe that animals possess this power of abstraction, as I have already shown. They abstract qualities common to various individuals; the dog has an abstract idea *cat*, as something possessing certain qualities which are obnoxious to him, and render the possessor a fit subject for him to persecute; and so with other animals whose ideas embrace not only individuals but also classes, they perceive resemblances and differences, and are thus enabled to recognise individuals as belonging to this or that class. Like the deaf-mute, the ordinary child begins thinking by this visual representation, and it is in this way that the deaf make their imitative signs. The visual images of these signs afterwards take their place in the mind as convenient representatives of thoughts, just as the audible images of words do in the minds of hearing people.

"There is nothing in mind which was not previously in sense," and the first thoughts are imaginary sensations. These sensations are grouped together, and form what the psychologists call percepts. Afterwards the percepts are associated with the expressions or symbols used to communicate them. Thus, hearing people, who are accustomed to express themselves in words, think generally in sounds, but frequently in visual images; while the deaf-mute generally thinks in visual images; and those who are both deaf and blind, in touches, tastes, and smells. As thought is primarily carried on in terms of sense, when one sense is cut off the others attain proportionately-increased activity.

Kruse, who was himself deaf and dumb, writing* about the mental development of his companions in affliction, says that the qualities which in his mind constitute the difference between things when he imitates objects and actions for the purposes of communication, become suitable marks which serve to fix them in his mind, so that he can memorise and recall them, and the signs thus become the means of thought.

On this point I have questioned several young people educated on the oral system, who, being perfectly deaf, have no idea whatever of anything like sound. At first my questions were misunderstood, and all asserted that they thought in words as we do. The hearing teachers also affirmed this of their pupils, and it was only with difficulty that I could make clear to them that, since our mode of thinking in words is simply thinking in sounds, it was impossible that the congenitally deaf could think in this way. After minute questioning, a fairly intelligent girl, 18 years old, maintained that she ordinarily thinks in signs or imaginary actions. That when she thinks of anything in reference to the deaf and dumb, she thinks in actions; but that when she thinks of hearing people, she thinks in words—that is to say, in certain groups of movements of the vocal organs, *not* in words as written or printed, although she reads and writes extremely well. A bright deaf boy of fourteen, taught on the oral system, told me that he thinks in words as spoken by himself, which means, of course, in certain groups of movements by which he is accustomed to express himself, but which we interpret by the sounds produced. Several others agreed that they think in the same way, but that the thought appears sometimes as written, sometimes as spoken by them or by other people. When they think of words as spoken by the mouth of another that person is the one with whom they chiefly converse, generally the teacher, which again illustrates the force of habit in regulating the mode of thought.

The form of dreams is important in illustrating the habitual mode of thought: thus it is believed that animals think and dream in visual images. In the dreams of those deaf and dumb who are taught on the old system of dactylology finger-twists play a large part. When Laura Bridgeman was asleep her fingers were frequently seen moving as in animated conversation, and deaf children taught on the oral system speak in their dreams. Thoughts are not bound down to any one set of signs, whether verbal or otherwise; but certain signs, which to the thinker are marks, mental shorthand notes, so to speak, are adopted in preference to others, owing to custom and convenience. A man cannot be said to know a foreign language thoroughly until he comes to think in its forms, instead of merely translating into them his thoughts from his native tongue. When he has accomplished the former, he will have so thoroughly assimilated the foreign tongue that he will dream in it. A French gentleman resident in England tells me that, for the first twenty years of his residence, he always dreamed in French, but that he now habitually dreams in English, the habit of thought of his later life having overcome that of his youth.

Although thought in its higher phases is to a great extent dependent upon language by means of which it is chiefly developed, thought must historically be anterior to language. Generals and particulars are apprehended, comparisons, distinctions, and inferences, made remembered, and applied without the use of language both by the lower animals and by men.

The case is clearly and humorously stated by Professor Whitney, who says: "To maintain that the idea waits for its generation until the sign is ready, or that the generation of the idea and of the sign is a simple and indivisible process, is much the same thing as to hold, since infants cannot thrive in this climate without clothing and shelter, that no child is or can be born until a *layette* and nursery are ready for its use, or that along with each child are born its swaddling-clothes and its cradle."* He continues: "The mental act is momentary, its formulation in words occupies time; we have our thought to start with and then go on to give it deliberate expression. The operation of thinking in words is a double one; it consists of thinking and of putting the thought into words; we conceive the thought and conceive also its expression. That when we turn our attention full upon our own minds, we read there the act and its expression together does not necessarily prove more than the intimacy of the association we have established between our conceptions and their signs, and the power over us of the habit of expression. Every

* "Ueber die Taubstummen."

* Whitney's "Language and the Study of Language," p. 412.

deliberate thought doubtless goes through the mind of the deaf-mute accompanied by an image of the dactylic writhings which would be his natural mode of expressing it;* but his mental action is not slavishly dependent upon such an external auxiliary."

That we deliberately clothe our thoughts in words according to the double process here described is undoubtedly true of a great number of thoughts; but in a vast number of cases words are present in the mind as marks of thoughts which it is unnecessary to call up in full, and these words are used as stepping-stones from one reasoning to another.

## FIRST STAR LESSONS.

By RICHARD A. PROCTOR.

THE constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct):—

1. *Ursa Minor*, the *Little Bear* (*a*, the *Pole Star*).
2. *Draco*, the *Dragon* (*a*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*a*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*a*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*a*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Bootes*, the *Herdsman* (*a*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*a*, *Vega*).
15. *Cygnus*, the *Swan* (*a*, *Arided*; *β*, *Albireo*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*a*, *Aldebaran*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*a*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*a*, *Regulus*).
24. *Virgo*, the *Virgin* (*a*, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*a*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*, the *Fishes*.
31. *Cetus*, the *Sea Monster* (*a*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*a*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*a*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*a*, *Alphard*).
36. *Crater*, the *Cup* (*a*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*a*, *Antares*).
39. *Sajittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*a*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*a*, *Sirius*).
45. *Argo*, the *Ship*.

INEFFICACY OF THE EUCALYPTUS.—Notwithstanding the positive statements that have been made as to the suitability and value of plantations of *Eucalyptus globulus* in swampy and marshy districts, some scepticism has been manifested upon the point, and some time since a paper attributed anything but favourable results to the experiments made in this direction in Italy. In a recent report on the Lucknow Horticultural Gardens (*Gard. Chron.*) Dr. Bonavia records a similar experience, and expresses a wonder that the tree should have ever been thought suited for the purpose for which it has been claimed to be efficacious.—*Medical Press and Circular.*

* "Indeed, I know that the children of the late Principal of the Hartford Deaf and Dumb Asylum, who had grown up in the asylum, and knew the peculiar language of the inmates as familiarly as their English, could always tell what their father was thinking of, as he walked up and down in meditation, by watching his hands: his fingers involuntarily formed the signs which were associated in his mind with his subjects of thought; while, at the same time, doubtless, he imagined also their spoken signs" (p. 213).

## LIGHTNING.

By W. SLINGO.

MR. PROCTOR, in his "Gossip" a fortnight since, demonstrated very simply and clearly the inability of an observer to determine the direction, whether from cloud to earth or earth to cloud, of a lightning flash. This is a fact the truth of which I anticipated, although I did not essay to prove it, in my article on "The History of a Lightning Flash" (KNOWLEDGE, No. 146.) I might now, perhaps, venture on a presentation of the proof in a manner differing from the process adopted by Mr. Proctor, but I take it that such a course is, under the circumstances, unnecessary.

There still remains, however, the question, Can or does, a lightning-flash strike upwards? This question I in part answered in the above-mentioned article, by observing that "it is just as likely that a discharge may travel upwards as downwards." It is to present an answer to this question that I am now writing.

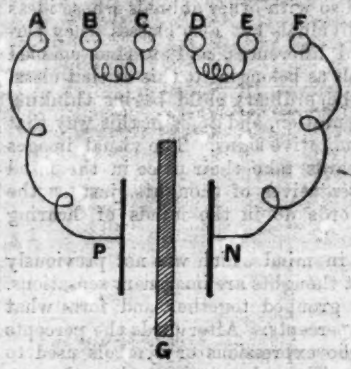



Fig. 1.

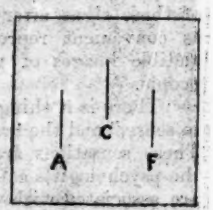
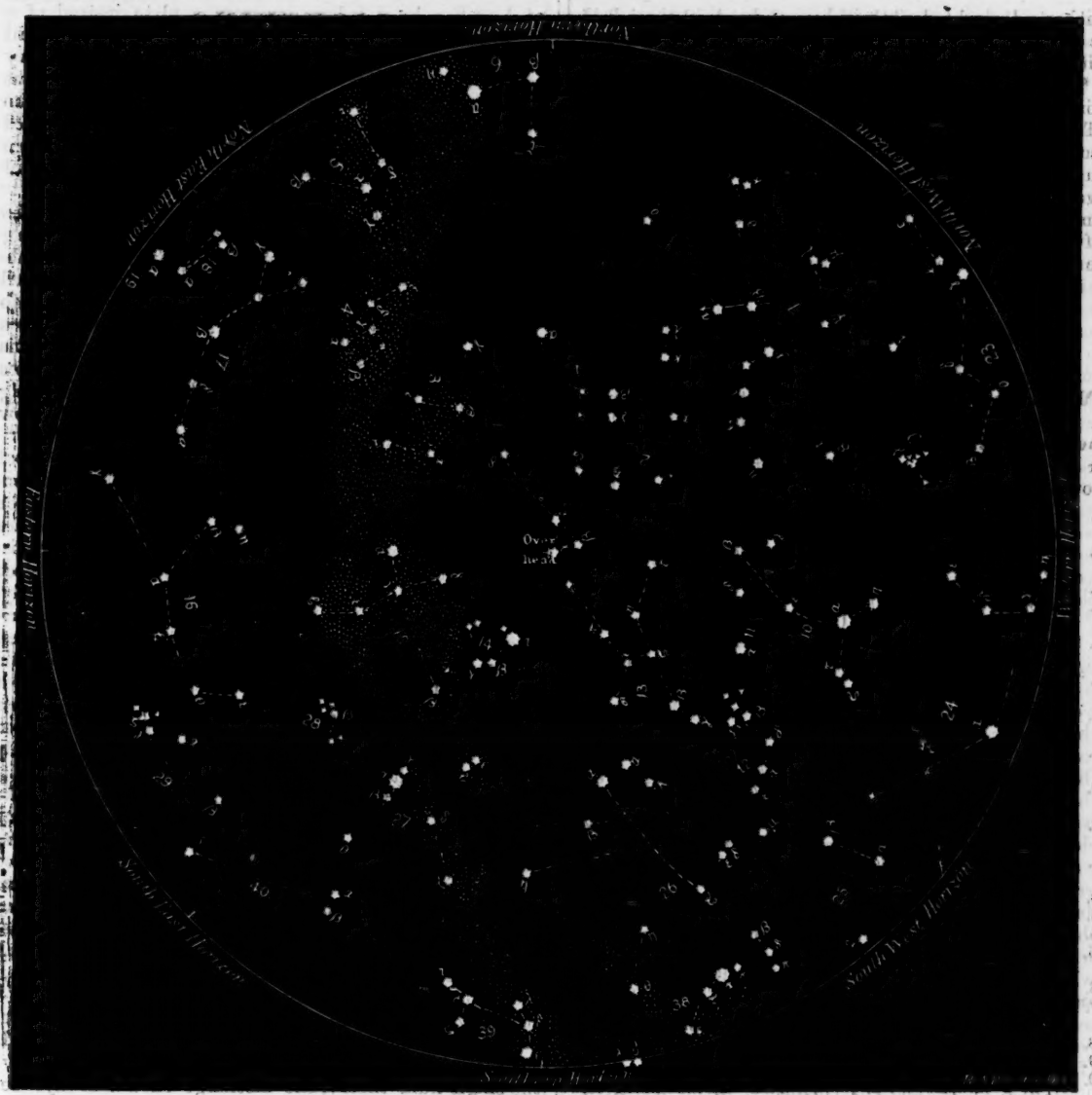



Fig. 2.

In the first place, we are aware that the atmosphere is sometimes positively, at other times negatively, charged. If, therefore, we determine in our own minds that the discharge can only take place in one direction, positive to negative, or, conversely, negative to positive, then it is clear we must concede the possibility of a discharge *from* the earth as well as *to* it. Now, however great may be our reverence for the single or double fluid theories, neither of them is capable of helping us. By the single-fluid theory, the discharge should always be in one direction (electrically speaking). But the adherents of this theory are unable to determine to their own satisfaction whether the plus or surcharge exists in the positive or negative state. While it has generally been claimed that a positively electrified body has an excessive charge, there are not wanting those who maintain that this excessive charge belongs to the negatively electrified body. By the double-fluid theory we are asked to believe that when a discharge takes place it is accomplished by the mutual exchange of a portion of the charge on each of the oppositely electrified bodies. Now this would mean that a discharge of positive electricity should take place from the positively to the negatively charged body, and that at the same time a discharge of negative electricity should travel from the negatively to the positively charged body. This, if it means anything, means that two distinct discharges, starting simultaneously from the two charged bodies, are necessary to produce a state of neutrality. But, inasmuch as the performance of work




NIGHT SKY FOR JULY (SECOND MAP OF PAIR),

Showing the heavens as they appear at the following hours:—

| | | |
|---|---|---|
| July 16 at 10½ o'clock. | July 27 at 9½ o'clock. | August 8 at 8½ o'clock. |
| July 20 at 10 o'clock. | July 31 at 9½ o'clock. | August 12 at 8½ o'clock. |
| July 24 at 9½ o'clock. | August 4 at 9 o'clock. | |

is inseparable from time, small though the lapse of time may be, it follows that the loss of, say, positive electricity on the positively excited body would not coincide exactly with the accession of the corresponding amount of electricity necessary to produce neutrality. In other words, when the two bodies are separated by a medium of considerable extent, there should, at each surface, be two flashes of light travelling in opposite directions and capable (with the aid of suitable apparatus) of being distinguished.

Let us call to our aid the (what I may style classical) experiment of Sir Charles Wheatstone. The accompanying diagrams illustrate the experiment. P and N (Fig. 1) are two pieces of metal separated by a glass plate or other insulating substance, G. Wheatstone used a Leyden jar, his object being to ascertain the speed at which electricity travelled. But any other form of condenser will answer equally well. Let us conceive the metal plate P to be charged positively, and connected to the ball A, while the plate N is charged negatively, and connected to the ball F. Close to A, but not touching it, is the ball B, which is connected to the ball C by means of a quarter of a mile of wire. Close to C, but not touching it, is another ball D, which is likewise connected, by means of a similar length of wire, to the ball E. This, in its turn, is placed close to, but not touching, F. There are thus three pairs of balls, and in the event, therefore, of the charged plates P N being

discharged, three sparks will be seen between these balls. Looked at under ordinary conditions, the three sparks will appear simultaneously.

Opposite the balls, however, was placed a revolving mirror, making 800 revolutions per second, and the images of the sparks received by it were reflected on to a screen. It was observed on discharging that the images appeared in the manner shown in Fig. 2, A and F being simultaneous, while C was a little later. The retardation of the middle line or spark was calculated to amount to one 1,152,000th of a second; that is to say, this was the time taken by the discharge to traverse the quarter of a mile of wire between B and C or E and D, corresponding, *in this particular case*, to a velocity of 288,000 miles per second. From the lengths of the arcs, which were in all three cases identical, it was calculated that the duration of each spark was one 24,000th of a second. Had the discharge travelled from the positive plate P to the negative plate N, then a flash of lightning would have been seen pictured on the screen between each pair of balls, that between A and B occurring first, and the other two following in rapid succession. Had the discharge started at the negative plate the flashes would have been seen in the reverse order. Had there been (on the double-fluid hypothesis) a mutual exchange, Wheatstone would have observed, not three, but at least five sparks pictured, two occurring between A and B, two between F and E, and one between C and D.

The evident teaching of this experiment is that a lightning discharge *may* start from earth and cloud *simultaneously*, meeting at some central point. But are we justified in inferring that it always does so? I think not. I rather imagine that in the majority of cases the conditions are not altogether comparable with those of the experiment. The whole matter turns upon the question of electrical "tension," a term which may be defined as the tendency to produce an electrical discharge. Where, over a given area, there is the greater concentration of electricity, there will be, perforce, the greater tension. The distribution of electricity on a conductor is rarely uniform, varying very considerably with the shape. Where the greater prominences occur, there will be found the greater concentration of electricity, whence it is said that electricity accumulates at points; and it is well known to the merest tyro in electrical science that this concentration at points results in a proportionally increased tendency to produce a discharge. If, then, a certain quantity of electricity is confined to a cloud, and that quantity, acting inductively upon the subjacent earth, produces an equal degree of electrification (of the opposite kind), it follows that, in the majority of cases, the charge on the cloud will be at a greater tension than that on the earth, for the simple reason that, more often than not, the cloud is more pointed or irregular in shape than the earth. As a matter of fact, the terrestrial charge is more or less uniformly distributed throughout the neighbourhood, while in the cloud there is a considerable concentration at the edge or pointed portion. Whence it ensues that, in the majority of cases, there is great reason to suppose that the discharge strikes downwards only. On the other hand, were the terrestrial surface provided with but a single point, such as is furnished by the well-known lightning protector, the discharge would only take place upwards. Moreover, the discharge would be a gradual, or, within certain limits, a continuous one, because the tension would grow so rapidly (as the cloud approached) that it would be quite incapable of retaining the charge. Had Wheatstone been able so to modify his experiment as to place at A or F a huge sphere, or even a plate instead of a small ball, and, conversely, to substitute for F or A a still smaller ball approaching even a point, there is to my mind little doubt but that he would have seen a different result. He would in all probability have obtained the sparks *in succession*, that near the small ball first, followed by one in the centre, and another striking the large surface. Now neither the single nor the double-fluid theories can adequately account for this.

We may, however, regard the charged cloud and the subjacent electrified earth as the extremities of a long elastic chain of electrically-polarised particles, each subjected to a series of stresses increasing in strength until it is compelled to yield. This chain, indeed, strives to shorten itself, and it is this striving that we know as electrical attraction. With the necessary facilities this shortening takes place, chief amongst these facilities being the physical elasticity or mobility of the intervening substance (or di-electric)—in this case, air—and the low electrical capacity of the charged bodies.*

We may compare the polarised chain to a rod of extended elastic held at the extremities until the extension is sufficiently great to overcome the holding or restraining power. If two oppositely-charged bodies have equal capacity, we can conceive that, when the discharge occurs, it will bear some resemblance to a piece of extended elastic set free at both ends simultaneously. This is exactly what happened in Wheatstone's experiment. Where the two bodies have different capacities, we may compare the polarised chain to a piece of elastic held more firmly at one end than at the other, whence it follows that the contraction will be one-ended, that which is less securely held corresponding to a charged body of small capacity, and which, therefore, speedily attains to the tension necessary to produce discharge.

In conclusion, then, the lightning discharge may take place (i.) simultaneously from earth to cloud and cloud to earth, (ii.) from earth to cloud, (iii.) from cloud to earth. The first form happens when the configuration of earth and cloud are (electrically) similar; the second when the earth is sharper than the cloud; the third when the cloud is more pointed than the earth, and it is this third form which I think most frequently ensues.

## RAMBLES WITH A HAMMER.

By W. JEROME HARRISON, F.G.S.

### FROM NUNEATON TO TAMWORTH—THE WARWICKSHIRE COAL-FIELD.

(*Continued from p.* 21.)

BUT we have not yet seen the finest exposure of the Cambrian shales. If, on leaving Hartshill, we direct our steps in a south-westerly direction to Stockingford Station (2½ miles), and then walk along the Midland line to Nuneaton, the following facts may be observed. Soon after leaving the station we note on the left-hand side of the line a large brick-pit, showing coal-measure shales and sandstones dipping at high angles to the south-west, and much disturbed, indicative of a fault (missed by the surveyors), which runs between the coal-measures and the Cambrian beds beneath. This line of

* Capacity is measured by the quantity of electricity required to raise the charge on a conductor to a given potential. A body which has the highest capacity is that which combines minimum surface with maximum content, viz., a sphere. In a body having, therefore, large capacity we should get low potential.

fault is actually indicated on the surface by the number of brick-pits which work the "fault-stuff," as the rubbed-up clayey matter between the two sets of rocks may be called; moreover, all the diorite bands end abruptly against it. Proceeding eastward, we enter a cutting in which the Cambrian shales are capitally exposed. They consist of grey, black, and purple to red shales—the latter lying at the base. They dip to the south-west at from 55° to 65°, and the height of the cutting is from 20 ft. to 30 ft. Nodules of manganese occur in the red shales, and they were formerly worked for this mineral at several points near Nuneaton and Hartshill. Fossils occur in the shales, but they are indistinct and difficult to find. The commonest shells are small species of *Lingulella* and *Obolella*, and with these are trilobites of the genus *Agnostus*. The collection of life-forms—such as it is—appears to place the strata near the base of the *Tremadoc Slates*—a division of the Upper Cambrian formation finely developed in North Wales. If this correlation be correct, the Hartshill quartzite probably represents some portion of the *Lingula flags*, which in Wales lie below the Tremadoc slates, just as the Hartshill quartzite lies below the Stockingford shales.

South of Nuneaton the quartzite is not seen, but the overlying shales can be traced past Chilvers Coton through Griffin Hollow to Marston Jabet. At the latter village—in an old quarry near the Hall—the shales are seen to dip *east*, at a low angle. They are here traversed by an intrusive mass of diorite, which forms two large bosses north-west of Marston Hall. The same easterly dip is found at the other end of the strip of Cambrian strata, north-west of Atherstone, where the beds—coal-seams and all—roll over and dip to the east.

Thus the north-east border of the Warwickshire coal-field is formed by a narrow fringe of Cambrian and Pre-Cambrian strata, which rise up sharply from beneath the Coal-Measures (from which they are separated by a line of fault), and occupy a tract of country nine or ten miles long by from half-a-mile to a mile in width. The structure of the region is that of an anticlinal, broken through by a fault in the centre, between Nuneaton and Atherstone, but preserving its crest to the south and to the north of these towns.

So far we have been concerned only with the eastern side of the Warwickshire coal-field. It is now time to turn our attention to the western boundary, the distance between the two being only from four to six miles. (Fig. 2.) The line from Birmingham to Derby runs parallel to the western outcrop of the coal-seams, and by walking from Kingsbury to Fazeley (little stations, the former five and the latter a mile or so, south of Tamworth), the principal facts can be seen in a few hours.

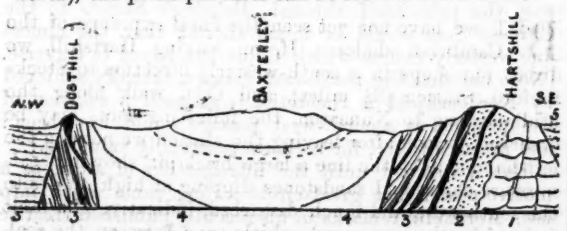



Fig. 2.—Section across the Warwickshire Coal-field, from Hartshill to Dosthill. 1. Pre-Cambrian Rocks; 2. Cambrian Quartzite; 3. Cambrian Shales; 4. Coal-measures—the dotted line shows the position of the limestone band; 5. Red Marls of the Trias.

From Kingsbury we walk northward for a mile along the line, over the new red marls, which are separated by a fault from the Coal-measures. The latter are well exposed in a long cutting, in which five distinct seams of coal can be recognised as black stripes between the beds of blue shale and sandstone. The strata dip eastward at a very high angle—70° to 80°—so that in several of the collieries the coal-seams have been followed from their outcrop almost vertically downwards to a considerable depth. The colliery-workings follow the coal-seams eastward, but in a westerly direction the lowest seam is broken and lost against the Cambrian strata, which here, as on the eastern boundary of the coal-field, have been thrust up along a line of fault. After examining the railway-cutting—which is entirely through the coal-measures—we turn to the left (westward) to study the Cambrian strata at Dosthill. Here there are several exposures in field-pits, brick-works, &c., of grey and black shales, which are traversed by countless numbers of worm-borings, so that one is tempted to refer the strata to the "annelidean stage" of the Cambrian epoch. The river Tame flows from south to north through alluvial flats along the western foot of the bold short ridge on which the village of Dosthill stands. The hard, dioritic rock rises so abruptly from the stream-course that at places the hill-side is nearly vertical; other igneous rocks here are dykes of a greyish decomposed rock, similar to those near Nuneaton. In a field-pit quite close to the high-road (on the west side), three-quarters of a mile due south of Dosthill Church, there is a very interesting section, showing a "neck" of igneous rock rising through the shales, and then spreading over them in all directions. In this respect, it is almost unique in the Midland counties (Fig. 3).

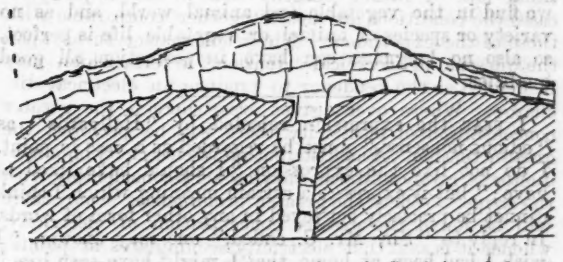


Fig. 3.—Trappean rock breaking through Cambrian shales at Dosthill, near Tamworth.

Standing on the summit of Dosthill the geological structure of the region can be taken in at a glance. The rocks at our feet dip eastward, to rise again in the Hartshill ridge. The coal-field lies like a wedge between two faults, which meet at Spring Coppice, five miles north-east of Dosthill, but which diverge as they extend southward. All the region between these two faults has been uplifted from 1,000 to 6,000 ft. Formerly it was covered, and the coal seams were concealed by a considerable thickness of triassic marls and sandstones; but these have been stripped off the uplifted area by rain and rivers, by frost and ice, and by the sea. But beyond the lines of fault—to the east and to the west, to the north and to the south—the red rocks encircle the coal-field. Beneath these triassic strata, in certain, though not in all directions, the coal-seams now lie at great depths—buried treasures which have been eagerly sought for by capitalists, who, availing themselves of the latest scientific improvements, have bored down more than a thousand feet in search of those "black diamonds" which some ten years ago were in such great demand, and which are absolutely necessary to almost every industry in this country.

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## TO OUR READERS.

ANY readers of KNOWLEDGE who may have been induced to subscribe either to *The Golden Argosy* or the *Household Journal*, on the faith of prizes offered in the advertisements which appeared in the columns devoted to them here on January 9, February 6, February 13, February 20, February 27, March 6, March 13, &c., &c., *and who have received no prize*, are requested to communicate forthwith with Messrs. BEST & PITTS, solicitors, 57 and 59, Ludgate-hill, London, E.C.

## Gossip.

BY RICHARD A. PROCTOR.

I AM glad to see our valued correspondent "Hallyards" (with whom however I do not always find myself in agreement — but what does that matter?) raising questions in regard to methods of speaking which are or seem to be incorrect. Although I find grammarians nearly always among the very worst writers of English, and regard the rules of grammar as derived from the study of good writing rather than as having authority in themselves, there can be no doubt that correctness in writing and speaking is a most important matter. Incorrect ways of speaking are apt to obtain currency, if not early shown to be incorrect. On the other hand, however, it should be regarded as a sound rule that where a mode of speaking, though not strictly speaking correct, supplies the only way of expressing some particular meaning, it should be admitted on that account alone. No language is absolutely perfect. For a language is the result of a process akin to the development we find in the vegetable and animal world, and as no variety or species of animal or vegetable life is perfect, so also no language can have in perfection all good qualities.

I FEAR the expression rejected by "Hallyards" as "odious nonsense," must be regarded as a case in point. I do not like the expression "I should have liked to have;" but it expresses a certain meaning which I think cannot be precisely conveyed in any other form of words. In reply to "Sir, Mr. C. called," one may answer, "I wish I had been at home, that I might have seen him," but this expresses rather more than the answer "I should have liked to have seen him,"—as this answer would always be understood. Neither "I should like to have seen him" nor "I should have liked to see him" is quite right. The former really means "I should like *now* to have seen him *then*;" the latter really means "I should have liked—at some past time not indicated—to see him." "I should have been glad had I seen him" implies a more general gladness as the result of seeing the visitor than the form "Hallyards" objects to.

"THAN whom," as "Hallyards" points out, may be correct, but "than who" is never written. Here we have an example of an incorrect expression which has established itself, even as "it is me" had nearly done. Prior has "than her" and "than me" inexcusably, and the other writers named by "Hallyards" have offended in the same way. Yet "than him," "than her," "than me," *may* be quite correct. Thus, "I trusted you more than him" is right, if it means "I trusted you more than I trusted him"; but if the meaning to be conveyed is, "I trusted you more than he trusted you," then of course we should say "I trusted you more than he." In like manner, if some one has said, "he trusted me more than John," meaning "he trusted me more than he did John," and any one doubted who had been named, he would ask "Than whom," but if the statement had been "he trusted me more than John (did)" the corresponding query *ought* to be "than who?"

I CANNOT say I find bad *grammar* in putting a pronoun before its noun. The practice interrupts the reader's thoughts; because either he has to wait till he finds out what or whom the pronoun may belong to, or worse, he starts with the idea that the pronoun certainly belongs to some other noun than that which eventually is found to be referred to. The practice is therefore objectionable. But every one who has occasion to write much knows that it is often very convenient to start with a pronoun in cases where the noun is referred to more than twice, or where other nouns are introduced which might be mistaken for the one we have to find a pronoun for. For instance, suppose we wish to say that "though Henry had taken no interest in Becket's play, he (Henry) somewhat inconsistently," &c.—then, whatever the preceding sentence may have been, or however it may at first suggest that the pronoun refers to Becket, it is convenient and proper to write, "Though he had taken no interest in Becket's play, Henry somewhat inconsistently," &c.; for if the pronoun comes last there is nothing to show whether it belongs to Henry or to Becket.

### GREAT-CIRCLE SAILING.

[A *great circle* on a sphere is one whose plane passes through the sphere's centre. A *rhumb course* between two ports or points is one in which the bearing is the same throughout. It is obtained on a Mercator's chart (invented for the purpose) by drawing a straight line from port to port, or from point to point.]

When the late Commander Maury in his "Sailing Directions," and in the celebrated chapter on "Sea-Routes," pointed out the advantage of studying the prevailing winds, in deciding on the course to be followed on a long journey, great-circle sailing had not come into vogue,—though in long journeys the rhumb course had necessarily been abandoned as unsuitable. It was known to seamen that the great-circle course is the shortest distance between any two points on the earth's surface, and in many cases a rough attempt was made to follow this course. The endeavour to find the north-west passage was to some degree a case in point; for on the journey from ports in western Europe to China the shortest (or great-circle) course would carry the voyager into the Arctic regions,—and if the Arctic seas could only be traversed, a course from British ports almost past the pole itself through Behring's Straits to the Chinese Seas would be much shorter than the almost due westerly course which Columbus hoped to traverse. [Note too that the north-east passage, actually achieved by Nordenskjold is theoretically as good a solution of the problem as a north-west passage would have been: and practically too, for both are practically valueless.]

But it was not until the introduction of steam as a motive power that great-circle sailing came much into use. Merrifeild remarks in his recently published treatise on "Navigation," that "as their method of propulsion renders steam-vessels in a great measure independent of winds and currents, their masters can choose their own routes; and as the shortest possible (all other things being [supposed] equal) is the one to be desired, great-circle sailing is coming into greater use than heretofore,

when vessels had to depend on the wind for making a passage." Yet, as a matter of fact, the advantages of great-circle sailing are greater, nay much greater, for sailing vessels than for steamships. Not only does it often happen that the great-circle course would take a ship into more favourable winds—as shown by Maury's charts—than she would find on the rhumb course—but even where no advantage of that sort is gained, and only a saving of distance effected, this saving is of more importance in the case of a sailing-vessel than in that of a steamship,—because it represents a greater saving of time and a yet greater relative diminution of sea risks. And the gain is greatest of all when a ship has to encounter adverse winds. For instance, if a steamship starts from the English Channel for New York on a great-circle course, she may gain about half a day as compared with her time on the Mercator's course. (I am not here considering "the greyhounds of the sea," but steam-vessels belonging to the carrying-trade.) To a sailing-vessel with fair but light winds the saving would be much greater, perhaps as much as a day and a-half or two days. But supposing westerly winds to prevail during the whole voyage, equally on the great-circle and on the Mercator's course, and that a sailing-vessel made 150 miles a day on the tack nearest to her course, then, on the rhumb-line, she would traverse, (thus tacking) a distance of 7,361 miles, and be 49 days on the voyage, whereas on the great-circle course the distance traversed in all her tacks would be 6,488 miles or 873 miles less, while the time occupied by the journey would be but 43⅓ days,—a saving of 4 days and 16 hours. (A sailing-vessel as close to the wind, supposed directly adverse, as she can, may actually on one or other tack be *increasing* her distance from the port for which she is making.)

## Reviews.

### SOME BOOKS ON OUR TABLE.

*Dictionary of National Biography.* Edited by LESLIE STEPHEN. Vol. III.: Baker-Beadon. (London: Smith, Elder, & Co. 1885.)—The third volume of Mr. Leslie Stephen's admirable work will suffer nothing in comparison with anything heretofore published with a cognate aim. Once more we find interspersed amongst lives of men whose names are household words the biographies of others whose mark in history has been so faint or obscure as to render it certain that it would be useless to look elsewhere for the story of their lives. The Baliols are here, as are Balfour of Burleigh, Archbishop Bancroft, Sir Joseph Banks, Barclay, Barham ("Ingoldsby"), Barrow, and Bathurst, side by side with Banting, the fat undertaker, and that "Dr. James Barry," Inspector-General of the Army Medical Department, whom many of our middle-aged military readers will remember as a bald little Scotchman, who used to sit on his horse and swear, and who, upon his death twenty years ago, was discovered to be a woman! In the biography of William Balle (p. 79), the authoress speaks as though his claim to have discovered the duplicity of Saturn's ring was first demolished by Mr. Lynn in the *Observatory* for October, 1882. *Suum cuique*, and we have not the slightest wish to detract from Mr. Lynn's undoubted claim to have largely assisted in pricking Dr. Kitchener's bubble; but—merely in regard to the matter of chronology—the reader is requested to consult pp. 294 and 295 of Vol. II. of KNOWLEDGE, which, of course, were published some days before the periodical referred to. It is pretty evident, however, from what source Miss Clerke derived her materials. We note one omission in the volume before us, which seems a little surprising, considering the general extremely complete character of the work. We refer to the fact that no mention is made of Sir John Barton, the Comptroller of the Mint early in the present century, whose great mechanical genius and power of invention certainly entitle him to a niche in Mr. Leslie Stephen's Temple of Fame. He was, we believe, the first man who practised the art of ruling lines in excessive proximity,—an art which in our days has culminated in the production of the so-called "Nobert's lines." Sir John Barton's iridescent buttons, produced in this way, were described by Sir David Brewster and Holtzapffel. He devised, too, an ingenious method of screw-cutting.

*Life, the Explanation of It.* By W. SEDGWICK, Major R.E. (London: W. Thacker & Co. 1885.)—A cursory perusal of this crazy book might impress the reader with the idea that it was a clumsy attempt on the part of its author to poke fun at the doctrine of Evolution. A more deliberate study of it, however, has convinced us that Major Sedgwick is really in earnest in advancing his perfectly wild hypothesis of the genesis of life on our globe. Whence, however, he obtained his science it is hard indeed to conjecture. How any man educated at the Royal Military Academy can gravely maintain the mechanical doctrines set forth in the opening chapters of the work, passes our comprehension altogether. For example, of the persistent action of gravity on a body projected upwards (p. 11) our author seems to have the haziest possible idea. Again: we learn on p. 16 that the earth has a mere crust of solid rock, and is liquid or molten inside. How the precession of the equinoxes happens under these circumstances we are not informed. Furthermore: (p. 18) "Compulsive force" is driving our system towards the constellation Hercules. This ought (according to Sedgwick) to produce a "vast visible source of light" in the direction of that constellation, and the reason why we fail to perceive this is "that our eyes . . . . are unable to appreciate the action of impulses of compulsive force, unless they are retarded to a sufficient extent by repulsive force." (!) Again, the exposition of the determining causes of the earth's orbit, on pp. 28-30, are almost worthy of Zadkiel himself; while on p. 32 it is gravely stated that the moon is attached to the earth, and the planets to the sun, "by columns, more or less conical in form, of gaseous particles." It will surprise no one to hear that the expositor of such astronomy (?) as this persistently misspells the name of Sir John Herschel throughout the volume. The remainder of it we really will not weary the reader by commenting upon. Haeckel's theory is as the utterance almost of inspiration by the side of it.

*The Sextant.* By MAJOR H. WILBERFORCE CLARKE, Royal (late Bengal) Engineers. (London: W. H. Allen & Co. 1885.)—Written by a man obviously most thoroughly familiar with the instrument he describes, and personally skilled in the method of using it, this tiny book is in every respect excellent, and the very model of what such a work ought to be. Commencing with a description of the sextant itself and the methods of testing it, our author proceeds to explain how to make its various adjustments perfect, to take altitudes both at sea, and on land by the aid of an artificial horizon, subsequently described, and to observe lunar distances. To this succeeds the description of the artificial horizon just

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referred to; and then a paragraph on the lamp, and some simple directions for identifying the brighter stars complete the volume. All this is given in the tone and manner of a skilled and genial instructor who, with his pupil by his side, makes him go step by step through the various adjustments of the instrument, and stands by to note and point out any erroneous method of observation. We have detected two or three misprints, which should be corrected in the inevitable second edition. On page 8, line 2, "handsomely" is almost certainly meant for some other word; while on the bottom line of the footnote on page 26, "form" is printed for "sum." The silliest errata, however, appear on pages 28 and 40. On pages 3, 14, 17, &c., we read absolutely correctly 20″, 10″, 35′·5″, 29′·35″, 32′·15·8″, 21″ respectively for 20 seconds of arc, 10 seconds of arc, and so on; but in the two places indicated the dimensions of boxes are given as 16″ long × 10″ wide × 9″ high, and 18″ × 12″ × 1″—which is utterly senseless and meaningless in a book dealing with *angular* measurement. Evidently, if these boxes were placed a mile off, to subtend these angles number one must be 24·57 feet × 15·36 × feet × 13·82 feet, and number two 27·65 feet × 18·43 feet × 1·53 feet! These extremely few obviously typographical errata, though, cannot be held to detract from the value of a volume which should be obtained by every one who may ever have occasion to use a sextant either at home or abroad. When we add that its dimensions are 6 inches long by $4\frac{7}{8}$ inches wide, and $\frac{1}{16}$th inch thick, it will at once be seen that it is as portable as it is good and trustworthy.

*Wild Flowers worth Notice.* By Mrs. LANKESTER. (London: W. H. Allen & Co. 1885.)—How a certain amount of knowledge, and the power of identification, of the vast number of curious and beautiful plants which stud our woods, fields, and hedges, adds to the charm and pleasure of a country ramble, must be experienced to be appreciated. In the volume before us Mrs. Lankester offers herself as a guide to all who wish to acquire this enviable accomplishment, and by the aid of plainly-worded descriptions and a profusion of coloured illustrations, really does supply a very considerable amount of information indeed. This is a book to be studied before starting on a country jaunt, and carried in the traveller's pocket, that he may recognise flowers on the spot. As far as we have been able to test the work, we have noted only one mistake, and that occurs in Plate II., where the figure of the prickly poppy is lettered "Horn Poppy," and that of the real horn poppy "Prickly Poppy." How such an obvious blunder passed the keen scrutiny of our authoress we cannot conceive.

*French-Polishing.* By A PRACTICAL MAN. With forty-two illustrations. (London: Wymans & Sons.)—This fresh volume of Wyman's Technical Series is distinguished by the same thoroughness that has characterised its predecessors. Whoever its author may be, he has amply justified his *nom-de-plume*, for his book is practical from beginning to end. Moreover, French-polishing proper, exhaustively as it is treated, occupies a comparatively small portion of the work, which contains, besides, directions for repairing and matching furniture and inlaid work, imitating various woods and marbles, staining, stencilling, ebonising, and varnishing, and is, in fact, crammed with information. No one who is ever engaged in the multifarious operations of which it treats should be without it.

*Catch Questions in Arithmetic and Mensuration, and How to Solve Them.* By Rev. A. D. CAPEL, M.A. (London: Joseph Hughes. 1885.)—Just now an internecine war is being waged between the examiners appointed by the Civil Service Commissioners on the one hand, and the crammers, who prepare pupils for the various competitive examinations, on the other. The examiners rack their ingenuity to devise catch and trap questions, and the crammers employ all their diligence to circumvent them. Mr. Capel's manual, ostensibly prepared for the use of candidates for matriculation, really renders yeoman's service to the noble army of "coaches" generally. The student who can contrive to master the host of "dodges" and artifices here set forth, may face the arithmetical examiner with the lightest of hearts.

*The Young Collector. British Butterflies, Moths, and Beetles.* By W. F. KIRBY. (London: W. Swan Sonnenschein & Co. 1885.)—The commendation we bestowed on p. 483 of our last volume on Mr. Kirby's Entomological Text-book may be extended most unhesitatingly and ungrudgingly to the really admirable and absurdly cheap manual whose title heads this notice. In truth, the incipient entomologist will do himself an injustice if he does not procure it. Not the least striking thing in it is the curiously faithful way in which insect markings are reproduced in the mere black and white of ordinary wood-engraving. In fact, as we remarked on a previous occasion, in the case of insects with whose colours the reader is familiar, it is not easy to persuade himself that he is not viewing such colours themselves in the illustrations with which the work abounds. It is a book to be bought by everyone who can get clear of the sound of Bow bells, if it be only for four days in the year.

*Successful Advertising; its Secrets Explained.* By THOMAS SMITH. Seventh annual issue. (London: 15, Wine Office-court, E.C.)—Mr. Smith's amusing book does what it professes to do: explains how, why, where, and when to advertise with the certainty of ensuring success. It contains a quantity of statistics illustrating its subject, and a list of the various newspapers, journals, and magazines published in London and the provinces, with their circulation, and notices of the various classes among which they do circulate and which they severally specially address. Hence tradesmen, the directors of public companies, publishers, and others, may learn for themselves what medium to select to bring their specialities prominently before those immediately interested in them. Every advertiser may get a "wrinkle" out of this volume.

*Magic Squares. New Methods, embracing a General Method.* (Dundee: R. S. Barrie. 1885.)—This, in a very compact form, practically covers the whole question of the formation of "magic squares," and may be commended to all who are interested in a very pretty arithmetical recreation.

*The Season.* July, 1885. (London: the *Season* Office.)—Without discussing whether the present fashion of ladies' dress is becoming or hideous, it may suffice to say that from no periodical can more trustworthy information on its details be obtained than from the one before us.

We have also on our table *Ciel et Terre, The Journal of Botany, The Medical Press and Circular, The American Naturalist, Bradstreet's, The Sanitary News, The Tricyclist, Wheeling, Le Franklin, The Agnostic, The Bazaar, Exchange and Mart, Electricité, Medico-Legal Journal, South Australian Register, The Househunter,* and that Arabic scientific journal, of which we can neither decipher the title, contents, nor place of publication.

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THE number of visitors to the Inventions Exhibition last week was 150,053. Total since the opening, 1,572,618.

## CHATS ON GEOMETRICAL MEASUREMENT.

By RICHARD A. PROCTOR.

### THE SPHERE.

(*Continued from page* 25.)

### II. VOLUME.

*A.* And now we are to attack great Archimedean problem,—to compare the volume of the sphere and cylinder!

*M.* We have to all intents and purposes solved it already, in determining the area of the sphere.

*A.* That is strange!

*M.* It is as certain as that the quadrature of the circle is accomplished so soon as we have determined the circle's circumference.

*A.* I think I see your drift. We divide the circle into an indefinitely large number of sectors which in the limit may be regarded as triangles; and I suppose you divide the sphere into an indefinitely large number of spherical sectors (I know not what would be the name for them) which in the limit may be regarded as pyramids.

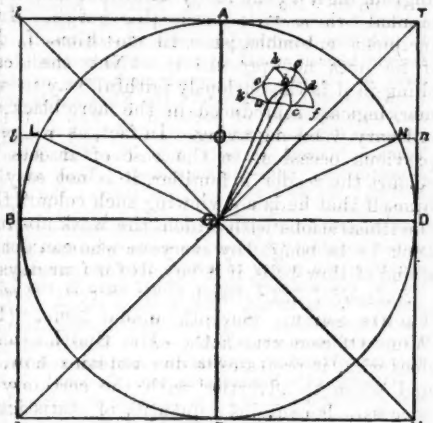

Fig. 3.

*M.* That is the way. Suppose *a b c* a very small spherical triangle, on the surface of the sphere A B E D, Fig. 3, whose centre is at C, and join C*a*, C*b*, C*c*. Then it is evident that if the sides of the triangle *a b c* are small enough, the difference between the solid sector C *a b c*, and the pyramid C *a b c*, on the triangular base *a b c* is evanescent compared with the volume of either the solid sector or of the pyramid, and may therefore be neglected. By taking other points *d*, *e*, *f*, *g*, *h*, &c. and making the triangles *b d c*, *d g c*, and so on, we can cover the whole surface of the sphere with small spherical triangles, the solid sectors corresponding to which make up the total volume of the pyramid. Now manifestly the sum of the surfaces of the plane triangles *a b c*, *b d c*, &c., is equal ultimately to the area of the sphere. Hence, Volume of sphere

= sum of volumes of the pyramids C *a b c*, C *b d c*, &c.

= pyramid having sum of areas *a b c*, *b d c*, &c., for base, and radius of sphere for height.

= pyramid having surface of sphere for base, and radius of sphere for height.

= $\frac{1}{3}$ rectangular parallelopiped having a base equal to the area of the sphere, and a height equal to the sphere's radius.

= $\frac{4}{3}$ rectangular parallelopiped having a base equal to a great circle of the sphere, and a height equal to radius of that circle.

= $\frac{2}{3}$ cylinder as *t* T Y *y* having base equal to great circle and height equal to the diameter of sphere.

= $\frac{2}{3}$ of a cylinder enclosing the sphere.

*A.* That is certainly not a very difficult solution. It is singular, by the bye, that the volume of the sphere bears the same relation to the volume of the enclosing cylinder, that the surface of the sphere bears to the complete surface of that cylinder.

*M.* Yes, putting the radius of the sphere equal to *r* we have

(1) Surface of sphere $= 4\pi r^2$
(2) Surface of cylinder $= 6\pi r^2$
(3) Volume of sphere $= \frac{4}{3}\pi r^3$
(4) Volume of cylinder $= 2\pi r^3$

Note also that if we have a cone with *y* Y one of the circular ends of the enclosing cylinder *t* T Y *y* as base, and A as vertex, then,—

vol. of enclosed cone : vol. of enclosed sphere : vol. of enclosing cylinder
:: 1 : 2 : 3

(*To be continued.*)

## Our Inventors' Column.

*We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions* (KNOWLEDGE *being a popular magazine*) *than is accorded by the most excellent trade journals.*

### LAWN-TENNIS POLES.

[Patent No. 10,776. 1884.]—This patent, taken out by Mr. R. Pearce Brown, Thorganby Hall, York, claims simplicity, neatness, and facility for fixing. Briefly described, it is a combination of lawn-tennis poles jointed to plugs driven into the ground, and capable of motion in the plane of the net, of toothed racks lying on the ground and stays jointed to the poles, the lower chisel-

pointed ends of which slide over the inclined teeth of the racks, and abut against the vertical sides of the said teeth of the racks, thus preventing the return motion of the poles. Thus, when it is wished to tighten the net, it is only necessary to separate the poles to the distance giving the required tightness to the net, when the poles are automatically fixed in the positions to which they have been brought, and the net is maintained at the required degree of tension. The makers are Messrs. Chas. Malings & Co., 18, Cockspur-street, W.C.

### STEREOSCOPIC PICTURES.

MR. W. E. CROWTHER, late of the Manchester Technical School, has devised a scientific arrangement for the production of stereoscopic effects in pictures thrown upon the screen by the lantern. The method is as follows: two lanterns are used, each of which projects one of the two corresponding stereoscopic transparencies upon the screen, so that both fall together upon the same field. The light from the lanterns, however, is not white, but of any two complementary colours, as red and bluish green. The spectators wear non-magnifying spectacles fitted with glasses of the same tints as those used in the lantern, and the result is that each individual sees one picture only with each eye, viz., the picture thrown from the green lantern is alone seen by the eye wearing the green glass, whilst the eye shielded by red glass sees the picture thrown from the red lantern. In this way each eye is affected only by its appropriate stereoscopic view, whilst the mind receiving simultaneously the two views in complementary colours combines them into a light and shade representation which possesses some peculiar properties of lustre.

The combined picture, as viewed by the naked eye, is for the most part white from the union of the red and green lights upon the screen. The stereoscopic differences of the pictures or overlapping portions only are chromatic. By slowly turning the lanterns so as to shift the screen-pictures slightly to the wrong side of each other, so that the optic axes of the spectator may intersect in front of the screen, the picture appears to advance and become suspended in the air before the screen.

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"Let knowledge grow from more to more."—ALFRED TENNYSON.

*Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.*

*All Editorial communications should be addressed to the* EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO, DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

*The Editor is not responsible for the opinions of correspondents.*

*All Remittances, Cheques, and Post-Office Orders should be made payable to* MESSRS. WYMAN & SONS.

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

## NATURAL SELECTION DEBATED.

[1826]—Might I take the liberty of asking Dr. Hutchinson to scrutinise the behaviour of his termites again. On Saturday, July 4, about an hour before sunset, I had an impromptu proof that *our* ants, at all events, *do* take unto themselves wings to fly away for the connubial operation—a much ado about nothing, I can assure ye!

Reposing in the paradisaical Italian evening behind trellissed vine, before mountain bluff, the swallows making the air *allegrissima* overhead, my attention was all at once called to a formiculating black patch on a low stone wall (once more taken possession of by Instinct, as though it had been Reason). It proved to be a colony of big black ants, very different from the red-headed, cock-tail little ones indoors, a few feet off. Lustrous jet black, pearly-winged queen-ants a lot of them seemed to be. Then there were two other sizes smaller. They deigned no notice of meat, bread, and sugar I brought them. Lo! right above my devoted head a column-like swarm in full swing. Such a sight! The small, almost tiny, males, innumerable (why so much more numerous?—*per* "Nat. Sel." ?) making me think of a chaos of Saturn's "rings" and, the while, renewing my marvel that astronomers—thoughtful, earnest men—so long blundered, except Cassini, with his flash of genius, about Saturn's "rings":—the first child whirling round a burnt stick might have taught them the truth!—the old Copernican truth—*apparence*. The ephemeral creatures seemed mad (fancy their tiny brains!) with excitement and pre-occupation. A stick, a hand, a handkerchief dashed through them made no difference. The females were few, and so much bigger than the microcosms of passion—the males—as to make these latter look ludicrous. Their union did not take place in the air, but after they had come down "flop" on to me, and the pillow I put. Then I noted, 'twas not the same species as the black patch before me—several of whose "queens" were slyly snapped up by a lizard time after time, who then retreated into *his* hole to enjoy the repast, by no means killing the protesting, wriggling victim straight off. Happily, I doubt, the lower animals do not feel much.

The female ant in the air, as on the ground, seemed indifferent, in the charming feminine way. The myriad males went madly gyrating about her and above her, and then, at last, one or two literally knocked her down (*piombavano a terra*). There was another swarm close by, and another and another in my walk further on. *Ecco*, evidently a use of *these* wings, though why they should fly into the air to be knocked down to the nuptial couch, I am not clear. No birds of the air swooped on to my ants. This factor, of course, seems to make a difference. In fine, ants gradually—O, so gradually—"acquired" their faerie pinions (two pairs) *per* Natural Selection, *id est*, through inherited, cumulating, victor-variations, the happy individuals that "happened" to develop the first rudiments of wings, getting the best of it, and gradually exterminating or extinguishing their competitors—all this, I reiterate, doth unto me for one indubitably, *pro tem*, make Darwinism dubious.

And here I may assure your courteous correspondent "Gamma," who finds *the* pleasure of thinking for himself, that our lamented illuminato, I may say staked his reputation on this, the doctrine of Natural Selection; although he, with his Shakesperian temperament and genius, is never to be confounded with those arrogant Positivists of his disciples who out-Herod Herod; whereof the irrepressible Haeckel, perhaps, is head and front offending—he who was so promptly and properly put down by Du Bois Raymond for claiming the irrepressible Goethe as a great poet, but far from giving us "measureless content"—his academic Faust will not compare with the flesh-and-blood Hamlet as an anticipator of Darwin. Haeckel, *der junge freund* of the Master, who did not quite speak as became him of the Master, but rather as though he were the great Darwin, not in the tone that became him—it is the tone which is so objectionable in these extremists; it was, *e.g.*, in Wagner—especially of the Master's knowledge of German (of course!) But to resume. If "Gamma" will turn to *our* "New Testament" he will at once see that "Natural Selection" *is* Darwin. He expressly cites the eye as being the result of Natural Selection—likewise the whale's mouth (subtly-furnished cavern!); and other divinely complicated cases. He evolves all from one, *vid* Natural Selection; that is Darwinism.

Now, though we do *seem* to see one protoplasm, even now the origin of animal life and form (not seeds?) yet mark, it is individual, *respective* protoplasm, *already within a fully-evolved life and form—the Mother*. Thus upon the threshold *sul stellato soglio* we are in doubt as to Evolution itself; grand propriety though it seem to be, truly scientific, like Nature's way—that it is "the result of Natural Selection" we may be pardoned for continuing to hold to be "debated and debatable." It took five hundred years for Christianity to establish itself; Darwin himself would be the last to complain of our threshing away at his *ism*. His grand merit was to electrify thought. Darwin himself "discovered" the Niata cattle and Ancon sheep, &c., striking cases of variation by leap and bound, such as "Gamma" has in his mind's eye; and I still feel that the Teacher himself scarcely felt the full force of that; of Monstrosities, and—Metamorphosis. Look at the case of the Medusa; the zoea and nauplius stages; the chrysalis and butterfly—more beautiful than poet's dream! Will Darwin say that these magical, miraculous transformations (at the side-scenes) were "acquired"? How can we imagine the simple hard chrysalis acquiring the power to evolve into the magnificent butterfly, by useless rudimentary steps, which gave it the advantage in the struggle for existence. But, if these things transpired by LAW—the Unsearchable, Ubiquitous, Self-Existent, Imminent God—then they seem more conceivable, or, at least, receivable; just as the Inorganic World is; gravitation-soul'd star-rich space.

With regard to Shakespeare, too. Curious! Just as "Gamma" was penning his letter I was thinking of writing to you to inquire, Can Natural Selection account for Shakespeare? Yet a little while and his ancestors were besmear'd barbarians of the Stone Age, confronting Cæsar (marvellous destiny! little England with her honours thrust upon her!) Like Burns, he sprang from the toiling-moiling million. Neither by Class nor Circumstance, it would seem, had his seraphic brain had the way prepared before it. What Evolution, what Natural Selection, ages of practice and conquest, turned out that? But Shakespeare *may* have had Cæsar's own blood in his veins, or Plato's. He must not forget, too, that his Age, the men of it, were a magnificently potent (not impotent) race, of which, over there in Cæsar's Italia, the world-man Columbus was the true Coryphæus—and the world-man Galileo; and the world-man of science, the Columbus of Urania's America, the Proto-Martyr of Science, Giordano Bruno.

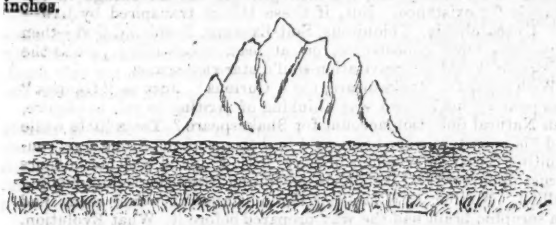
Beethoven, too (the only peer with Shakespeare), came after those Columns of Hercules, Bach and Handel, in a musical age like a great tree in flower. The profounder inquiry remains, what made the race take such a giant-stride and saltation of genius? Nay, specially, what made this Nineteenth Century do so? Ages of cunning and brutality, of lust and drunkenness, by wretches who knew not how many beans made five, scarcely at first sight seem to explain Shakespeare and Beethoven *per* Natural Selection; scarcely seem to explain their immense *pure* brains. Yet it may be so; at least, in part. The spectacle of these centuries we now perceive to be the Star of the Teutonic Race in the ascendant. But their civilisation, that has indeed advanced by leaps and bounds, towered by Titanic impulses. With regard to music, I think Darwin's doctrine immensely suggestive; more subtle and profound than Spencer's—viz., that man's music is the outcome of ages of animal evolution; that we are *so* moved by music because, unconsciously, we thrill with the recollection and experience of æons of animal ancestry or pre-existence; wherein, from the nightingale up to the eagle, lion, and gibbon, we employed the Voice in the most intense period of our life-history, during passion, when the female was the centre of all existence; and male warred against male, to monopolise her, with the fiercest drunken joy; thereby also helping on his own evolution, and (according to Darwin's beautiful, if unproven, speculation) Beauty—Beauty the nearest form of God!—Music seems to me infinitely *more* than this: Prophecy *rather* than Past; as it were, the

besouled flesh and proof of Immortality; still, the idea of the Prophet of this generation (what went ye out for to see? A man blameless and beautiful as the lily, illumined as the starry heavens) is, in its way, grand.

Perhaps I may be thought inconsistent, but in these tentative contributions I am labouring, rather feeling my way, to the part as it were of judge, if possible, if I may say so, not Advocate for or against; though I confess that the Theory of Natural Selection, as the cause of evolution, seems suspicious to me; likewise, indeed, the theory of Evolution (from one) itself, in spite of the vastness of the plausibility of its generalisation. For example, the very *sine qud non* of his theory is;—*if* a victor-variation happens to show itself:—but, now, it occurs to afterthought that this very *if* may not take place, not be the *modus operandi* and scheme of things; but, on the contrary, that, like the "Solar System," (even in its inconceivable flight towards Hercules) *all may swing together*: that no perturbation can occur in the sub-solar system without compensation; that the Imminent Cause, from everlasting to everlasting, *in* all, may take order for it (I do not here say consciously); that *pari passu* shall be the order of the day, of the tremendous slow march, that one of its dearest words shall be and abide, as before quoted, that from the lips of *the* Chrysostom, *the* Poet, greatest Humility and greatest Heroism, "Not a sparrow falleth to the ground but what your Heavenly Father knoweth it!" ALEXANDER TEETGEN ("Commentator").

## NOTE ON INDIAN TERMITES.

[1827]—In my paper on Indian termites, I alluded to the indomitable energy and perseverance with which white ants annexed the bell-beam in the church tower, or the beams of the house built over their nest. Recently I witnessed this energy in another direction. An ant-hill had been levelled to make way for a long line of road-ballast; this, made up of laterite fragments, ran parallel to the road, and its width and height were four feet and eighteen inches respectively. Offended at having been thus slighted, the termites, in *one* night, rebuilt their hill, *running it through the densely-packed laterite*, and raising it eighteen inches, with a base of thirty-six inches.



Now, think for a moment what this implies. These mites, determined upon not being sat upon, and scorning the mountain suddenly imposed upon them, *determined on boring and building through it;* and this they did. Consider the enormous labour implied in each termite wriggling through the rough angular masses of laterite, each laden with its pellet of mud; and not only is the mud to be carried for the heap on top of the ballast, but also for the sides of the tortuous passages through the closely-piled laterite. Except for their aspirate excelsior craving, these indefatigable workers could have pushed their works on each side of the ballast-heap; but their doing so would be contrary to their principles, and imply defeat. R. F. HUTCHINSON, M.D.

Pachmari, June 21, 1885.

## VITAL FORCE.

[1828]—If it were not so sad in its consequences, it would be amusing to note how disbelief, in order that it may put on a certain seeming of respectability, clings to tenets only to be reconciled with belief. "F. W. H." appears to be incapable of discerning that the doctrine of necessity totally excludes the conception of right and wrong, for whatever should happen by necessity could happen in no other way. Theft, murder, &c., would all be in the unalterable course of things. We owe the distinctions of right and wrong to a belief in a Supreme Being, that determines what men ought and ought not to do. Without such ruling a man could by no possibility do wrong. If he committed murder, suicide, or anything which we now call criminal, by necessity he would do it by nature's compulsion, in the natural course of things, and be blameless.* Hence my piteous appeal, as "F. W. H." is pleased to call it. Your correspondent says, "knowledge supersedes belief;" that is quite true, but, unfortunately, your scientific pundits too often forget that that knowledge which they deem so very absolute and positive, is only the outcome of a *belief*—of a belief in the existence of an external world, of matter, &c. This belief in a material universe is as much a belief as that in the existence of a Supreme potentiality. There is, in fact, no *positive* knowledge but that of our own existence and of the mathematics. Sir John Herschel aptly termed the mathematics, "the very soul of science." How any one who has adopted the teaching of the Doctrine of Necessity can be so illogical as to talk of transgressing the laws of nature is truly surprising; there can be no transgression under necessity. It will come to be seen that from the standpoint of my letter (1759) on Vital Force that the evidences of a Ruling Power are as strong as the evidences of a material universe. Berkeley and Lewes have been frequently referred to in your correspondence columns, but the writers in every case appear to me to have missed the point of their teaching with respect to "Idealism," which was that the existence of matter could no more be demonstrated than the existence of a Ruling Spirit. In both cases you have to rest on belief; and, if nothing else should move men to cling to the doctrine of a Ruling Power, the very utility of such a belief should. METER.

[* See Professor Clifford's Essays on "The Ethics of Belief" and "The Ethics of Religion," in the collected edition of his "Lectures and Essays."—ED.]

## INSIDE OR OUT?

[1829]—"J. S." (1801) is mistaken in supposing that my views are in any way modified. I would point out that the words "external" and "independent" are not synonymous. The former involves the assumption that the relation of the world to the mind bears an analogy to the relation between two bodies in space; the latter simply implies that the world continues to exist when we cease to be conscious of its existence, and that it did so exist during the untold ages when sentient life was not. It is clear, however, that this cannot be true of the phenomenal world which we know, and with which alone we are concerned; since this is composed of our own sensations and thoughts. When I said that "every valid concept must certainly be correspondent with a thing," I used the word "thing" in the sense of "object"—i.e., a synthesis of sensations. This, of course, cannot properly be said to "represent" anything, since a sensation is the simplest element of consciousness. An object is not a re-presentation, but a direct presentation. That a concept may be "non-valid" is clearly proved by the concept of idealism in the mind of "J. S." It is especially funny that he should commend to my notice a passage from G. H. Lewes, which is not even Hylo-idealism, but pure Berkeleyism. C. N.

[Following the argument of "C. N." to its logical conclusion, it would seem that the sole difference between the audible suggestion of the Demon of a gentleman in Hanwell, and a speech of Mr. Gladstone is, that the one "is composed of the sensations and thoughts" of an individual in confinement, and the other of those of a reporter at large.—ED.]

## GASES AND GRAVITY.

[1830]—In letter 1,805, What does "Hallyards" mean? Take the case of a jar full of carbonic acid and hydrogen; both gases are resting on the ground. Why is this an exception to the universality of gravitation? "Hallyards" says that "carbonic acid gas should always be the lowest." This seems equivalent to saying that in a room full of people those of sixteen stone "should" be on the floor with the lighter people sitting on them! F. G. S.

[Not quite! Shake oil and water together in a bottle for half-an-hour, and then set the bottle "on the ground," and you will find that the oil will at once separate from the water and float on the top of it.—ED.]

## THE GENESIS OF THE MOON.

[1831]—If there is "nothing impossible" in the "extravagant paradox" cited by "Hallyards" (see letter 1779) concerning the pre-lunar origin of the Arcadians, and the extraneous origin of the moon, it is at least a paradox at variance with the few facts we possess concerning the moon's early history, and the many reasonable deductions which have been inferred from geology and the consideration of the tides.

That the tides are older than the possible age of man is scarcely open to doubt. Rivers, storms, glaciers, &c., are all inadequate to account for the varied phenomena of geological formations. The tides are a requisite agent, and not merely tides such as we now see, but tides of much greater magnitude and power. In necessary sequence it is generally held that the tides are gradually subsiding, a fact only to be explained by the supposition that the moon is ever widening its orbit, and that in earlier times it was in much closer

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proximity to the earth, a supposition which gives us the "chip of the old block" theory. If the moon's advent in our system were as recent an occurrence as "Hallyards" considers possible, the geological formations would give unmistakable record of the fact, and even sufficient evidence to form an approximate date. The solar tides are of comparatively little importance, and could never be confounded with the lunar tides.

With reference to the colour of air, I cannot conceive a reason why aqueous vapour should lose colour by being condensed, or why the particular formation of the particles of water in aqueous vapour should "show the colour."

By admitting "Hallyards'" statement, that "A Scotch or Irish landscape looks much bluer than a French one," his idea (that the colour of the air is due to the water it contains) would lose its chief support, for the warmer the climate the more water will its atmosphere hold in suspension, which would give us the *maximum* of colour to the *minimum* of water, and *vice versâ*. It is only fair to add, however, that this is not the case; as we proceed south the colour of the sky is intensified, and consequently the colour of the landscape.

It was the fine blue of eastern skies which gave birth to the "Waters above the earth" theory.

That the air of Mars may be all oxygen, and therefore more life-supporting than our own, is impossible.

In the first place, life is maintained by the utilisation of that property of oxygen, of readily combining with other elements to its own contamination; and, secondly, an atmosphere of pure oxygen could never exist in the presence of many other elements essential to life; chemical action would ensue and destroy it.

The particular composition of our atmosphere must not be considered as the work of haphazard chance, but rather as the result of circumstances and causes which in all probability would be also active in the planet Mars. "Hallyards" has entirely misunderstood me in supposing I complained of his "*may be's*"; he is at liberty to draw an inference if he can give sufficient reason for doing so; it was the *because* I could not allow, the reason he gave why oxygen might be red, was directly opposed to a fundamental rule of chemistry, which makes the properties of a chemical compound independent of the properties of its elements, whereas, "Hallyards" seems to ignore the existence of such a force as affinity, and argues as though the properties of a compound were the *sum total* of its ingredients: and the same mistake also occurs in the following:—"oxygen may well be blue, since water contains nine-tenths oxygen." From a chemical standpoint, oxygen and nitrogen *cannot* be "frozen" or vapourised (hydrogen was never mentioned); but, taken in a broader sense, "Hallyards" is no doubt correct in assuming that all matter may be either gaseous, liquid, or solid.

ALEX. MACKIE.

## THE DIRECTION OF LIGHTNING.

[1832]—Several years ago, late in summer, and in the dusk of evening, I was on an open vehicle on a very exposed road, when a hailstorm came on, to protect myself from which I put up my umbrella, and as the wind was at my back some of its ribs necessarily pointed upwards, whereupon they immediately became tipped with the most beautiful pencils (*not stars*, mind you) of electric light I ever saw, affording thereby conclusive proof of the *direction* of the current. Which being so, it now rests with those who deny that lightning ever strikes *upwards* to show, if they can, how it happens that what is possible under a *weak* electrical tension is "impossible" under a *strong* one.—Yours faithfully,

WM. ALLMAN.

N.B.—In the great thunderstorm of June, 1846, which heralded the potato failure in Ireland, the direction of the flashes of lightning was, mostly, neither up nor down, but horizontal.

[The phenomenon witnessed by Mr. Allman was the ordinary "brush discharge," familiar to all users of a frictional electrical machine. What I understood the Conductor of KNOWLEDGE to deny was, not that lightning strikes upwards, but that *it is impossible for the observer to see this*.—ED.]

## GEORGE ELIOT.

[1833]—This journal is specially interesting to me as being (I think) of a unique type, "conducted" by one, "edited" by another. "So far as we can make out" (said the *Saturday*, in 1874) "Lord Hartington is to act the part of a highly-respectable man, content to be outshone whenever it pleases Mr. Gladstone to throw the full solar splendour of his mind on any subject." You, Mr. Editor, inserted the views of "Commentator" on the late Mrs. Cross, and shortly after, on the same subject, gave us a note of your own condemning public approval of concubinage. Now, these pronouncements—"C.'s" explicitly, your own implicitly—have given "intense pain" to our eminent conductor. "Something rotten in the state of Denmark"—or, let us take Japan. The Mikado resumes the reins of power, displacing the Shôgun.

*Trêve de plaisanterie.* I thought faith and morals* were to be kept out of *K.*; but, since it is not so, I implore Mr. Proctor to state *explicitly* whether he really teaches that it is right and *laudable* for any individual to dispense, for his own convenience, with any particular precept, civil or religious, which may chance to hamper him for the moment.

If so, then there is no more law of any kind for anybody. As thus, The sole standard of conduct for individuals has always been the rule settled by the society of which they form part. It is erroneous to suppose that Christianity is the basis of our European code. Horace derived stricter principles from his father than any young Italian of our day from his. I doubt whether any man ever was put to death for unchastity; but vestals were, when Rome had as much dominion over Italy as we now have over the Soudan. No Christian child is ever guarded so strictly as were the young Pagans—"Odisti claves, et grata sigilla pudico." Yet this very same people gave a father the option of destroying his new-born child! In Lydia, the "whole duty of woman" when young, consisted in earning her dowry by prostitution. In Assyria, every woman was obliged, as a religious duty, to submit to prostitution once in her life—(cunning fellows, those priests of Myrtilla—Herodotus says no amount of money would induce an Assyrian woman to sell herself afterwards)—Now, were these acts sinful? No, says the Catholic Church; they violate no natural law, and so "heathens, and ignorant Christians, may live as the beasts without being in sin." I have no doubt, that, for this reason Polynesian girls are as fair morally as they are physically. But as regards *Europeans*, the uniform result of my experience is that a woman who disregards the standard of her society is *morally hideous*, and falls behind *in every respect*. The hetæræ of Athens were not degraded by cruelty, rapacity, theft, and drink as are ours.

Renan remarks that *very few* have the right to reject Christianity. I do not believe Miss Evans was one of these few, for the simple reason of her sex. Women admit *themselves* they do not reason, but *feel*. Moreover, a woman who decides that all religious belief is false commits an act of extreme arrogance which does not prepossess. The pictures of George Eliot and Mr. Lewes are, both of them, perfectly repulsive to me.

In 1858 (and later) it was the custom at Brighton (and elsewhere in England) for men to bathe from machines perfectly naked. In 1868, any man so doing would have been not only fined, *but thought immoral*. So true is it that public opinion for the time being is the only law we may not violate.

The sanction accorded by society to George Eliot is merely another instance of the idolatry of *success*, which makes one blush for one's species. Without, it Lord Tennyson would not have taken Miss Evans as a housemaid. With it, he adorned her drawing-room. But why stop at her? Go on to George Sand. *Her* liaisons were legion. Why should she be fettered?

I conclude by a few comments on some of Mr. Proctor's words (which I run no risk of imagining, since I have them before me):—

"Of the relations between G. E. and G. L. it becomes none to judge, unless it can be shown that any one was personally wronged in the matter." How about the popular phrase "the injured wife?" And, without that, are there no acts which do no harm to any one, but which society justly abhors and persecutes? "Even then, judgment by an outsider would be improper." Nay: Mr. Proctor forced us to judge, by giving us *ex cathedrâ* Miss E.'s views on Immortality—of which she could know no more than any one of us. "To all intents and purposes, save as regards the letter of the law, G. E. was G. L.'s wife." I imagine Mr. Proctor *minus* his purse, and the taker saying the above, *mutatis mutandis*. Then *I* would say "*Quis tulerit Gracchos?*"

"Had the legal ceremony been performed." The Catholic church teaches that "in the sacrament of matrimony, the minister is the sponses themselves." The essence is the consent of the parties, *if free*. But one of the parties here was not free. "They were united by a tie which was to them perfectly sacred." So is the burglar to his spoil.

Mr. Proctor has apparently every reason to be content with the institution of matrimony, I am in exactly the contrary position; yet I have never desired to be free, or contemplated a "privately-sacred" arrangement, believing that it is for the benefit of society on the whole that marriage should be dissoluble only by death.

Mr. Proctor's doctrine seems to be that anyone may give himself a private dispensation from the settled rule. How much more

* Questions of faith, as pertaining to theology pure and simple, are, and must be, rigidly kept out of these columns; but ethics admit of treatment at once from a psychological and a sociological point of view, and hence are perfectly in place in a journal devoted to science.—ED.

rational is the Catholic theology; which, while labelling innumerable acts as mortal sins, yet admits that inadvertence, or vehement passion, may render them *in particular cases* only venial. Thus the perfection of the code is maintained, while it is left to God alone to say whether in any given case there is guilt. The sin is detestable, but the sinner may not be detested, because he cannot tell, even himself, whether he is sinning, or merely yielding to human infirmity. HALLYARDS.

## OUR BOYS AT SCHOOL.

[1834]—If you will permit me, I will make a few remarks on the subject of "Our Boys at School."

Three-quarters of a century ago Sydney Smith wrote an article very similar in its condemnation of public schools to the article in KNOWLEDGE last week, so the subject is not a new one. It is of course a truism to say that the moral tone of a school depends to a great extent on the masters and headmaster, but unless we are to take it for granted that the tendency of English schoolboys is to bully and become Tasmanian devils, the influence of public opinion in a large school must be greater than the influence of an usher in a small school, however close and prying his supervision may be. To say there is a savage idea underlying the working part of our public school system is certainly an exaggeration, if not a distinctly mistaken view of the system altogether. Bullying may be encouraged in certain public schools, it certainly was not at Rugby, but to say that it is encouraged by the system of monitors shows a complete misunderstanding of the system.

Sydney Smith says, "at a public school every boy is alternately tyrant and slave." From the article in KNOWLEDGE a reader would imagine that a boy passed immediately from being a fag to being a monitor. Such, at any rate, was not the case at Rugby. At least one-third of the school was called the Upper School. As a rule boys took a couple of years to pass through the Upper School, and, while in it, were neither fags, nor could they exercise the powers of monitors. On the whole, they represented the best physically, intellectually, and morally. They held the balance of power between the Sixth and the Middle Lower Schools. If the Sixth had unduly exercised their power, a house levée or a school levée would have been called, and the Upper School would have taken the side of right against might. If a combination of fags had unreasonably refused to obey certain orders of the Sixth, the Upper School would again have decided the matter equitably.

To the boy of average capabilities, physically, intellectually, and morally, there is not the slightest doubt the public school system is the best system of training. For the exceedingly precocious, or for the extremely weak physically, intellectually, or morally, it may not be the best, but if it is not they are exceptional cases, and require therefore exceptional treatment.

First, the physical advantages. In a large public school each boy can find some game suited to his strength. He has a choice of cricket, racquets, fives, rowing in some, gymnastics, or volunteering, and in winter football and paper-chases. In a smaller establishment a boy is confined to cricket or lawn-tennis, or walks with Mr. Barlow, after the manner of Tommy and Harry in "Sandford and Merton." Should a boy be fond of bird-nesting or geologising, he will find just as much opportunity in one as the other of indulging in his pet virtue or vice, as people may consider it. What public schools are referred to where there is daily kicking or weltering with a stump on cricket afternoons, it is difficult to guess. The present writer has travelled and resided in nearly every part of her Majesty's dominions except Canada, and has met men in them from every public school worthy of the name, but, so far as he knows, he has never yet met the schoolfellows of that statesman who *possibly* owes his greatness to being daily kicked at school. He (the writer) was about four years at Rugby, some twenty years ago, and the only cases of bullying he ever heard of were in spite of the public school system, and occurred in the Lower and Middle Schools, the bigger boys in a form bullying the smaller ones; but they were isolated cases, and soon put a stop to by the form-master. What with a matron to every fifty boys, and doctors' certificates, and masters joining in the games, surely the danger of anything brutal occurring is reduced to a minimum. But is King's College School, where the recent case of bullying occurred, conducted on the public school system?

Secondly, intellectual advantages. When the writer was at school, Latin verses and Greek classics were considered a necessary part of the public school curriculum. Such is not the case now. But it is very doubtful whether what a boy learns is really of as much importance as how he learns it. Until a boy is sixteen or seventeen he does very little more than learn how to learn. The writer, who has had some little experience in teaching boys, but not English boys, is of opinion that up to a certain age making a boy use a gradus or a dictionary properly is as good a training for the intellect as botanising or showing him experiments in chemistry, electricity, and the like. In a large class it is certainly a more convenient mode of educating. To suppose that one system or another would produce more Tennysons, more Huxleys, or more than our one general, is to misunderstand the subject of school education generally, and public school education more particularly. The majority of boys attain such a low standard of knowledge in any and every subject, that in practical life it makes very little difference to a man what he has learnt at school. At any rate, the great majority of boys learn at a public school how to learn sufficient of the particular subject which they are learning to prevent themselves being punished. In a private school, where more attention was bestowed on them out of school, they might not even learn this, though they might get through more book-work. But private tuition can always be obtained, if desired, in a public school.

Thirdly. The moral advantages. It is the experience of the writer and everyone he has consulted on the subject, that the standard of morality in public schools is higher than it is in private schools, but, of course, much depends on the masters. Considering the manner in which headmasters and masters of public schools are appointed, and the opportunities the public have of criticising their conduct, they must, as a rule, be the best men available. A boy should be therefore more likely to learn at a public school than anywhere else that purity is more manly than impurity, that honesty is the best policy, that lies and deceit are the weapons of sneaks and cowards, and that those that speak the truth always are brave men. JOS. W. ALEXANDER.

## MYSTERIES AND MORALITIES.

[1835]—Anent "Mysteries and Moralities," so ably explained in KNOWLEDGE by Mr. Clodd, there is an older and, to my mind, better explanation why the "pagan" festivals coincide with the "Christian" ones, viz., the theory that they spring from the same source, or the root of most existing religions, *i.e.*, solar worship. "Many," says Tertullian, "suppose, with greater probability, that the sun is our God, and they refer us to the religion of the Persians."—"Apologet," c. 16. Certain it is that all the "Christian" festivals correspond with the equinoxes, and summer and winter solstices. The "sun worshippers" of Mexico and Peru held dogmas almost identical with Christianity, viz., immaculate conception, crucifixion, resurrection, and redemption. F. W. H.

## BIBLIA PAUPERUM.

[1836]—In reply to Mr. Webb's inquiry, the following is the full title of the work referred to in my paper on Mystery Plays:—"A Smaller Biblia Pauperum, conteynynge Thyrtie and Eyghte Wodecuttes Illvstratynge the Lyfe, Parablis, and Miraclis off Oure Blessid Lorde and Savioure Jhesus Crist, with the Propre Descrypeiouns theroff extracted frō the Originall Texte off JOHN WICLIF, somtyme Rector of Lutterworth. With Preface by the late Verie Rev. ARTHUR PENRHYN STANLEY, D.D., Dean of Westminster." Square 8vo. Bound in Parchment, old style; brass clasps; price 10s. 6d. Published by Mr. Fisher Unwin, Paternoster-square.

I have, however, not had the opportunity of comparing this with the *Biblia Pauperum* preserved amongst other early specimens of block-books in the British Museum, and of which a facsimile was published in 1859, but I have an impression that the "wodecuttes" are replicas of blocks from an old German book of the sixteenth century. EDWARD CLODD.

## "HOW TO GET STRONG."

[1837]—I think Mr. Proctor's rules for strengthening the limbs will be disappointingly like the French plum-pudding, which failed because the receipt had omitted all mention of the pudding-cloth. It is a principle that "involuntary motion does not tire;" hence our hearts go on beating all our lives without crying for a rest. A gun is lighter than a cane, if we have hope of sport. A walk without a friend or an object is a saddening affair. In a gymnasium I used to wield clubs and dumb-bells, and got strength thereby, because there were comrades and admirers. Had I been alone, I should have been tired in a few minutes; and I suspect my muscles would have "sucked thereout but small advantage." I can conceive few things more lugubrious and ridiculous than, say, an elderly gentleman, with *K.* on a music-stand beside him, solemnly moving his arms up and down *secundum artem*. A lathe or a joiner's table would give him far more strength. So it would to send off

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the servants, and do all the work for himself. I have tried that, and it is capital fun. In a short time it gets as natural as shaving, or soldiering. HALLYARDS.

## FORGOTTEN GEORGIAN PHRASES.

[1838]—"When George Primrose's cousin says to him: 'May I die by an anodyne necklace; but I had rather be an under-turnkey in Newgate,' who is there in the present year of grace who knows what he means? It appears that it was a notorious quack charm against the perils of teething, and that mothers never forgave themselves if their children died of convulsions without having tried an anodyne necklace. We may point out that the editor's ingenious note, in which he quotes an advertisement in which it is said to be sold for 5s., 'as patronised by the King for the Royal children,' does not quite exhaust the question, for what George's cousin says is: 'May I die *by* an anodyne necklace,' which looks as though, if some regarded it as a medicine, others had found it to be a poison."—*Saturday Review*, Jan. 12, 1884, on Mr. A. Dobson's "Vicar of Wakefield."

Is it not pretty clear that by "anodyne necklace" Goldsmith meant *the halter*—"an end to all my cares," as Sam Hall sings, with play of words alluding to the quack charm? However, all anodynes are poisons; and weakly babes *may* have died of the inhalation, an overdose for them.

A few lines further on, the Reviewer writes, "We are puzzled by the word 'sussarara.' Mrs. Symmonds says to her husband, "Gentle or simple, out she shall pack with a sussarara." Mr. Dobson quotes one authority which gives as the meaning of the word, "a hard blow." It is met with, in a slightly different form, in Sterne."

I have often heard my aunt (born in 1793) say of a delinquent servant, "She deserves a good *sesserero*" (so I should spell it, pronouncing as if it were Italian or Spanish). I always understood this to mean a scolding: there could not have been any question of striking. It is remarkable that domestic words of the other day should be already of doubtful meaning. HALLYARDS.

## LETTERS RECEIVED AND SHORT ANSWERS.

WILLIAM MILLER. You will probably have gathered from a reply of mine to another correspondent how much I am in accord with you. But, as far as I am concerned, I am impotent in the matter. —F. G. S. Source of quotation previously pointed out by Mr. Smallpeice.—DR. LEWINS. Received, and carefully read.—BALANCE. Oh, dear, no! It is very possible, indeed, for an unskilful rope-dancer to fall while holding his balancing-pole. A little consideration will show that the centre of gravity of the performer must be vertically over the rope. If it gets outside of the vertical, and the man has no means of shifting it, over he goes. The use of the pole, which is heavily loaded at each end, is to shift the centre of gravity when needed, *e.g.*, if the man finds himself disposed to topple over to the right he moves his pole towards the left, and so brings the common centre of gravity of himself and the pole into a point whence a perpendicular would pass centrally through the rope.—SENEX. Sodium vapour arrests luminiferous vibrations of the same refrangibility as those which it emits; but not necessarily *all* such rays passing through it, unless it be of sufficient thickness. If I stretch half-a-dozen pianoforte strings across an opening and tune them all in unison to, say, A; and then on one side of that opening the note A is blown clear and loud on a cornet, it will be deadened to a certain extent, but a good deal of the sound will get through. By multiplying the number of strings, though, I might ultimately get sufficient to take up the whole of the undulations starting from the cornet, so that the cornet note should never reach the listener's ear at all. So with sunlight. It is partly arrested by the sodium vapour surrounding the sun; but some of it gets through, and if we destroy this latter portion by passing it through a sufficient thickness of terrestrial sodium vapour, we ultimately get the D lines really black.—F. W. H. I have been compelled to stop the discussion on mind and matter. *Inter alia*, it brings letters taking the forms of sermons, which I must perforce exclude, at the risk of being accused of admitting only one side of the argument. I just, however, record your recommendation to Mr. Alexander to read Haeckel's "Pedigree of Man" for himself.—TYCHO. It depends upon the meaning you apply to the word. Of old, lunatics were regarded as "moon-struck." For some curious details as to the supposed physical influence of the moon on sleepers in its light in tropical climates (to which you possibly refer), see Vol. VI. of KNOWLEDGE, pp. 305, 325, and 348.—REV. S. T. B. PEPPIN. I am sorry to exclude your temperately-written letters; but the reply to "Commentator" really assumes the form of an excerpt from a sermon. One thing is abundantly evident, and that is that you know nothing whatever of the writings of the greatest and most philosophical naturalist the world has yet seen. It is by no means necessary to "shut our Bible" before we "open our Darwin." So devout a Christian and good a Catholic as Professor St. George Mivart is a staunch evolutionist. Just consider how the Church has had to succumb on such scientific questions as the motion of the earth, its age, the date of man's first appearance on its surface, the origin of death, &c. This may possibly tend to abate a little of your "cock-sureness" that the clergy *must* be right, and men of science wrong, on subjects which the latter have made the study of their lives, but of which the former are ludicrously ignorant. See the letter of "Meter" in another column as an example of the only way in which such a question as you raise can be discussed in a purely scientific journal. Note too my reply to "F. W. H." above, concerning the closing of the "Mind and Matter" discussion.—DR. BARNARDO. Thanks for your invitation, but I must once more reiterate that the whole thing is foreign to the purpose of a journal like this.—H. J. BIDDLE. The subject in which you are interested has never been treated of in these columns; and had it been, a rigid rule exists against the presentation of KNOWLEDGE gratis to any club, institution, university, or library whatever.—J. H. COBBETT. You would infallibly have trodden on some one's theological corns, and had I refused to insert a column or two of pulpit declamation in reply to you, I should have been charitably branded as "lending KNOWLEDGE to covert attacks on the faith," &c., &c. The amount of rampant bigotry existing in this last quarter of the nineteenth century would astonish you.—BAIN FRERES. Received.—THOROUGH BASS. I am ignorant of any work published in this country having special reference to Canadian farming, but you will find a mass of information which cannot fail to be of use to you in "Outlines of Modern Farming," by R. Scott Burn. Crosby, Lockwood, & Co. publish it, as they do also Youatt & Burn's "Complete Grazier," which is an encyclopædia of cattle-breeding and raising. Both of these are bulky books. I know of no very cheap ones that are worth anything.—OLD JOLLY. The conductor is, or will be in a few days, on the high seas (I trust not suffering from the height of the seas on). I do earnestly hope, though, that he will see your protest before he is "the death of" you! Should any such deplorable result ensue, I, as representing him *pro hac vice*, should certainly urge strongly on the proprietors of KNOWLEDGE the obligation they would be under to give you a public funeral, with a neat and appropriate brass over your vault, setting forth the circumstances under which you terminated. Why do you not employ some of your illimitable power of "chaff" in answering "Hallyards & Co."?—LIEUT.-COL. DOONER. Received.—CARL SIEWERS. Any and every book sent here is committed to an expert in the subject on which it treats, for careful perusal and review.—F. C. COLLINS. All the space available for such recreations is already given up to Chess and Whist.—J. OSBORNE, CONSTANT READER, and AN INDIFFERENT WHIST PLAYER. Shall be handed to "Five of Clubs" on his return.

## Miscellanea.

NITROGEN is solidified at a temperature of −214° and under a pressure of 60 atmospheres, its critical point being −146° under the pressure of 35 atmospheres. By carrying the rarefaction to 4 mm. of mercury, the author has succeeded in obtaining a temperature of −225°. The solidification point of carbon monoxide is −207° with a pressure of 100 m. of mercury, Oxygen still remains liquid at a temperature considerably below −211°.

SIXPENNY TELEGRAMS.—The amendment which the new Postmaster-General intends to propose when the Bill comes on for discussion is one which, we imagine, will stand but little chance of being accepted by the House. His scheme is to allow addresses to pass free, to charge sixpence for the first three words of the message and a halfpenny for each subsequent word. This would operate most unfairly upon the best customers of the telegraph, who usually adopt sender's addresses of the briefest character. If anything is to be passed "free," it certainly should not be the sender's address, whatever may be urged in favour of so treating the address "To."

THE results of eleven months' use of toughened glass beakers are thus summarised by Mr. R. F. Friswell, in a paper read before the Chemical Society:—"Of twenty beakers, two burst spontaneously, = 10 per cent.; one burst on hot water being poured in, = 5 per cent.; six became useless from fissures and enfoliation, = 30 per cent.; eight are in good condition, = 40 per cent.; three have been broken by unknown means, = 15 per cent. Taking into consideration the loss of confidence caused by the high percentage of spontaneous bursting, it may be said that toughened glass is a complete failure in the laboratory.

# Our Whist Column.

By "FIVE OF CLUBS."

## THE AMERICAN LEADS.

IT is noteworthy that much less is known about the so-called American leads in America than in England. Mr. Trist, of New Orleans, to whom these new principles (or rather these extensions of former rules) are due, communicated them to the *Field*, and there they have been under discussion by "Cavendish" and his school on the one hand, and on the other by "Mogul" and those who agree with him in regarding the modern system of play as at once too complicated and too clear. In New York I found few who knew anything about the American leads, and I waited till I reached New Orleans and had the advantage of Mr. Trist's own commentary on the new leads, before bringing them before the readers of KNOWLEDGE.

I have now fully examined the American leads, and have discussed them so far as was necessary, with Mr. Trist. I have even gone so far, in my anxiety to get information from headquarters, as to do what usually I do not care to do,—playing Whist with those not so fond of the game for the game's own sake as to play it without such added piquancy as money stakes possess for the less enthusiastic Whist brethren.

It is of course known to all who play Whist at all that from a suit of five cards not headed by such cards that a high card should be led, the lowest but one is the right card to lead. This lead, called the penultimate, has been extended to cases where there are six cards or more, in which case the lowest but two, or antepenultimate, is led. Many Whist players must have recognised the reasonableness of still further extending this principle, as by leading the lowest but three from a suit of seven cards. I think too that nearly every Whist player must have thought of the advantage which would arise if some distinction were made between the play from a suit of more than four and the play from a suit of four only, in other cases than those already provided for.

It is this want which Mr. Trist has met (and, as it seems to me, has effectively met), by the suggestion of the principles which I am now to describe.

Observe first that when we lead the penultimate from five, or the antepenultimate from six, we lead for the moment as if the cards below the one led, had no existence. We make, for instance, the same lead from King, Nine, Seven, Six, Four, Three, or from King, Nine, Seven, Six, Three, as we would from King, Nine, Seven, Six alone.

Now Mr. Trist proposes that in all cases where we hold more than four, we should—wherever it is possible—lead and follow the lead as if originally we had only held the four top cards of that suit; while, where this is not possible, he suggests a conventional system by which information may still be conveyed as to the original length of the suit.

The cases where it is possible to lead as from a four-card suit divide themselves into two classes:—

*First*, where a low card would be led originally: here we lead the fourth from the top according to the proposed system,—viz., the lowest but one from five, the lowest but two from six, the lowest but three from seven, and so forth.

*Secondly*, where a high card is led originally and followed by a low card: here we lead the proper high card, and follow with the original fourth card from the top. Thus from Ace, Queen, Ten, Five, Four, we lead the Ace and follow with the Five, instead of following with the Four as of old; from Ace, Queen, Ten, Five, Four, Three, we lead the Ace and follow with Five, instead of Three; and so forth. From King, Queen, Nine, Seven, with or without smaller cards, we play, according to the new system, King first and then Seven, instead of King first, and then lowest, as was formerly the rule.

The second class of cases is more important than the first, where indeed every case had been already provided for, except hands of more than six cards, which are unusual. Moreover, in cases of the second class the new rule is more effective in conveying information quickly, than in cases of the former class,—simply because more cards of the suit are played out. In fact, in every case of the second class the information given in the two rounds is bound to show that a long suit has been led from, and to indicate its precise length, or else that a signal has been begun by the enemy and withdrawn. Thus suppose the following two rounds, *A* being the leader:—

| *A* | *Y* | *B* | *Z* |
|---|---|---|---|
| *S*A | *S*2 | *S*4 | *S*8 |
| *S*7 | *S*5 | *S*K | *S*10 |

Here it is obvious that *A* holds the Three and the Six, for they have not fallen,—unless *Z* holds one of them, and played the Eight intending to signal, but afterwards changed his mind and withdrew the signal by playing the Ten. This last is very unlikely, nor does it affect *B*'s power of placing the higher cards in *A*'s hand. *A certainly* holds one of the two cards left below the Seven, and almost certainly he holds both; he also holds two of the three cards—Queen, Knave, and Nine; and the two must be either Queen and Nine, or Knave and Nine; for if he had held Queen and Knave he would have led one of them second round.

In the above case, only the knowledge accruing to *B* from the use of the new system of leading is considered; not any possible effect on *B*'s play. Suppose, however,—to take a convenient illustration of the effect of the proposed system, that, besides the Four and the King, *B* holds the Knave. Then, it is obvious that he is at once guided by the lead of the Seven to his proper course as third player second round. He knows that *A* holds the Queen and the Nine—of which fact (be it observed) he would have remained in ignorance had *A* led his lowest, second round. Therefore, if he plays the Knave he will block his partner's suit. He therefore plays his King, that his partner's suit may be cleared. Of course this would be his right play, anyhow; for the finesse of the Knave would clearly be unjustifiable. But in the following case *B*'s play is modified by the knowledge which his partner's play conveys (*B* holds Knave, Five, and Four):—

| | *A* | *Y* | *B* | *Z* |
|---|---|---|---|---|
| 1. | HA | H2 | H4 | H8 |
| 2. | H7 | HK | HKn | HQ |

Here *B* places in *A*'s hand two cards between the Ace and the Seven, which after *Y*'s play (but before *Z*'s) must be either Queen, Ten, or Queen, Nine, or Ten, Nine. If *A* holds the Queen it matters not how *B* plays; but if *A* holds the Ten, Nine, *B* can only do harm by retaining the Knave. Whether the Queen falls from *Z* or not, *B*'s Knave can do no good; but if the Queen *should* lie with *Z* then the third round falls to the Knave, if *B* keeps it and *A*'s suit is blocked.

Take again another case.

| | *A* | *Y* | *B* | *Z* |
|---|---|---|---|---|
| 1. | S A | S 2 | S Q | S 10 |
| 2. | S 7 | S K | Lowest Trump | S Kn |

In this case *B* safely ruffs with his lowest trump instead of his best, because he knows that *A* only holds two cards above the Six, which must be the Eight and the Nine; were it not for the use of the "card of uniformity" *B* would have been in doubt as to the position of the Knave, and his proper course would have been to trump with his best.

*(To be continued.)*

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A TYRO'S TRICK. Few things show Whist weakness and inexperience more than boasting of approaching success when sitting down to play, or claiming success, after it has been achieved, as evidence of superior skill. For every one who has learned anything of Whist knows that though superior skill must assure a balance of superior success in the course of a great many rubbers, the odds are very slight in favour of the most skilful players against the veriest blunderers at a single sitting. One of the finest players living lost 23 rubbers in succession, though most of the time he had an excellent partner. When you hear any one say, If you played with *our* club, you would lose money, you may be sure he knows nothing of the game; yet it would not be safe to infer that all or most of the members of his club are poor players.

WHIST CRITICISM.—When a man criticises another as a bad Whist player, without saying why he thinks so, it is well (if you wish to get at the truth) to ask him for his reasons. On sundry occasions I have elicited the following "exquisite reasons" for such general condemnation:—(i.) He played King the other day, third in hand, though he held the Ace. (ii.) He leads King from Ace, King, and others. (iii.) He leads King from King, Queen, and others. (iv.) He did not lead Clubs though he knew I had none, and that I had *plenty* of trumps to ruff with. (v.) He never leads trumps when he holds but one. (vi.) He goes on with trumps after he finds that he will be drawing two for one. (vii.) He positively led out his Ace, second round, from Ace, Queen, Ten, and another (after King, Knave had fallen), though he knew *Y* could trump the suit, for the play showed *Y* had two trumps left and he himself had only one (no one else had any). It is a compliment to be told by such people that they cannot understand your play, and the best compliment they can pay to be told by them that you play badly.

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## Our Chess Column.

By MEPHISTO.

### ILLUSTRATIVE GAME No. 2.

THE following game was played on the 14th inst. between Mackenzie (White) and Mason (Black) at the Hamburg International Chess Tournament. The game, which was very strongly played by the winner, exemplifies in a remarkable manner the effect of good development. Black very cleverly gained important time in the opening, and gradually increased the pressure of his attack until the life was crushed out of White's game :—

QUEEN'S SIDE, OPENING.

| White. | Black. |
|---|---|
| 1. P to Q4 | P to Q4 |
| 2. Kt to KB3 | Kt to KB3 |
| 3. P to K3 | P to K3 |
| 4. P to B4 (*a*) | P to QKt3 |
| 5. Kt to QB3 | B to K2 |
| 6. B to Q3 | P × P |
| 7. B × P | B to Kt2 (*b*) |
| 8. Castles | Castles |
| 9. Q to K2 (*c*) | B to Kt5 (*d*) |
| 10. B to Q2 | QKt to Q2(*e*) |
| 11. QR to Q sq. | Q to K2 |
| 12. P to QB3 | B to Q3 (*f*) |
| 13. P to K4 | P to K4 |
| 14. P to Q5 | Kt to Ksq.(*g*) |
| 15. B to KKt5 (*h*) | P to KB3 |
| 16. B to R4 | P to KKt4 |
| 17. B to KKt3 | Kt to Kt2 (*i*) |

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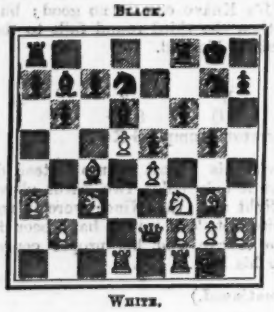

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| | |
|---|---|
| 18. Kt to K sq. | R to B2 (*j*) |
| 19. Kt to B2 | Kt to B sq. |
| 20. Kt to K3 | P to R4 |
| 21. P to KR4 (*k*) | B to B sq. |
| 22. Kt to Kt5 | Kt to Kt3 |
| 23. P × P | P × P |
| 24. Kt × B | P × Kt |
| 25. P to B3 | P to R5 |
| 26. B to R2 | Kt to R4 (*l*) |
| 27. Q to Q2 (*m*) | Kt(Kt3) to B5 |
| 28. R(Qsq.) to Bsq. | (*n*) R to Kt2 |
| 29. B to Kt5 | P to Kt5 |
| 30. B × Kt | Kt × B |
| 31. Q to Q sq. | P to Kt6 |

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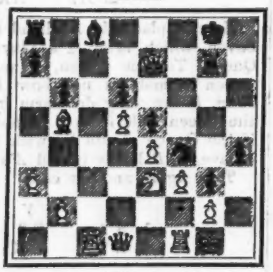

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| | |
|---|---|
| 32. R × B(ch) (*o*) | R × R |
| 33. Kt to B5 | Q to Kt4 |
| 34. Kt × R | Q × Kt |
| 35. R to K sq. | Q to QKt2 (*p*) |
| 36. B to B6 | Q to Kt2 |
| 37. R to R3 (*q*) | P to R6 |
| 38. P × P | Kt × P(ch) |
| 39. K to Kt2 | Kt to B5(ch) |
| 40. K to Kt sq. | P to Kt7 ! |
| 41. R to K sq. | R to B2 (*r*) |
| Resigns | |

NOTES.

(*a*) We learn by experience. The progress of this game, also previous examples of the same opening, shows that it makes a great difference in what order these moves are played. We think it desirable that both Castling and P to QKt3 should precede the move of P to QB4, the reason being that it would improve White's game if Black, by taking the BP, would give White a chance of retaking with the KtP. Black also gains time as in the text, for immediately White moves his KB, Black plays P × P, compelling the B to retake. For instance, if in reply to 4. P to B4, P × P. 5. B × P, P to QKt3, and it is White's move. But if in reply to 4. P to B4, P to QKt3. 5. B to Q3, P × P. 6. B × P we have the same position, but it is Black's move, or, in other words, Black has already on the 6th move wrested the advantage of the move from his opponent. Another advantage of Castling early is that by being enabled to play P to QKt3, in order to support the advance of the BP. White can also play B to QKt2, an important move which prevents Black from pushing forward to K4. It also makes it more dangerous for Black to take the QBP, as White eventually could bring the B to bear on Black's K side by P to Q5. For clearly, if the QB is not played to QKt2, then P to K3 blocking the B becomes worse than useless.

(*b*) Now, Black's QB is well posted, whereas White's KB attacks nothing, and his QB is blocked in.

(*c*) With the intention of advancing P to K4.

(*d*) Making P to K4 impossible, on account of B × QKt; also with a possibility of B × Kt followed by Kt to K5.

(*e*) Now, B × Kt would have enabled White to retake with B and get it into a position where it might be a little more useful than it is at present.

(*f*) Again occupying a commanding position.

(*g*) Necessary, in order to prevent Kt to R4 and Kt to B5, also providing a fresh line of play suitable to the alteration in the position.

(*h*) Putting the B in a position where he can be conveniently attacked by Pawns. As a general rule, it is always safe to advance the Pawns on the K's side when the opponent's KB is blocked by a P on Q5. Perhaps B to Q3 would have retarded Black's advance.

(*i*) The strength of Black's play consists in the principle not to push an attack rashly, but to advance steadily, and strongly supported. Every inch of territory is occupied by him before advancing. He does not at once push on the KtP, but brings his forces well to the front, and to bear upon the intended advance, which increases thereby in effect.

(*j*) White brings his Kt over to K3, via B2, where he seems better posted, and Black intends playing his QKt over to his K side.

(*k*) P to R3 is safe, this weakens White's position still more.

(*l*) Every move tells. Black prevents White from moving his KtP as a last resource.

(*m*) Here Q to K sq. suggests itself with a view to the possibility of playing P to KKt4, in order to arrest Black's progress.

(*n*) Played with a view to taking the B in order to relieve his game if possible that way.

(*o*) With that B on the board, Black's intended advance of the RP would become more dangerous.

(*p*) It is difficult to see a reason for this move except it be to entice White to play B to B6. This B is wanted on B sq. to prevent the advance of the KRP.

(*q*) White ought to have retired his B to Kt5, which would have enabled him to play B to B sq. in case White played P to R6, and if P to R7 (ch), K to R sq., it is not easy to say how White could win.

(*r*) A worthy termination of this well-played game. Black might have won the exchange by Kt to R6 (ch.), K to Kt2, P to Kt8 (ch.), R takes Kt × R (ch), but the move of R to B2 is far more effective, as Black now threatens to play Q to Kt6 and mate with the Kt, R to B2 being played to prevent B to Q7. Of course, if either K to R2 or B2, Black wins easily.

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